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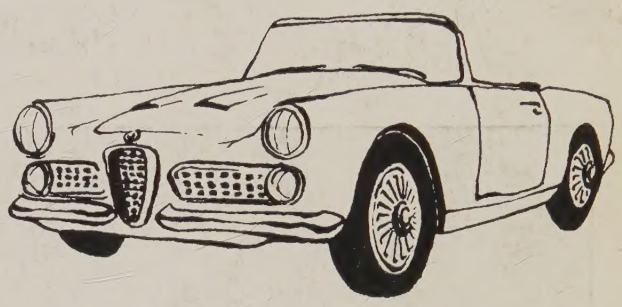

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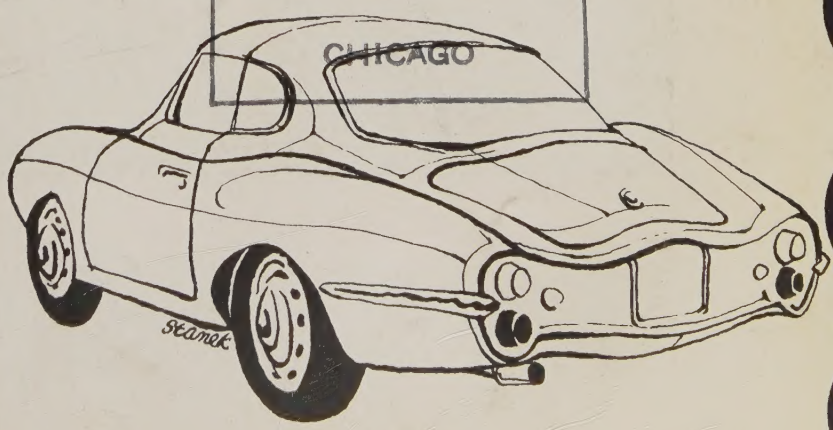

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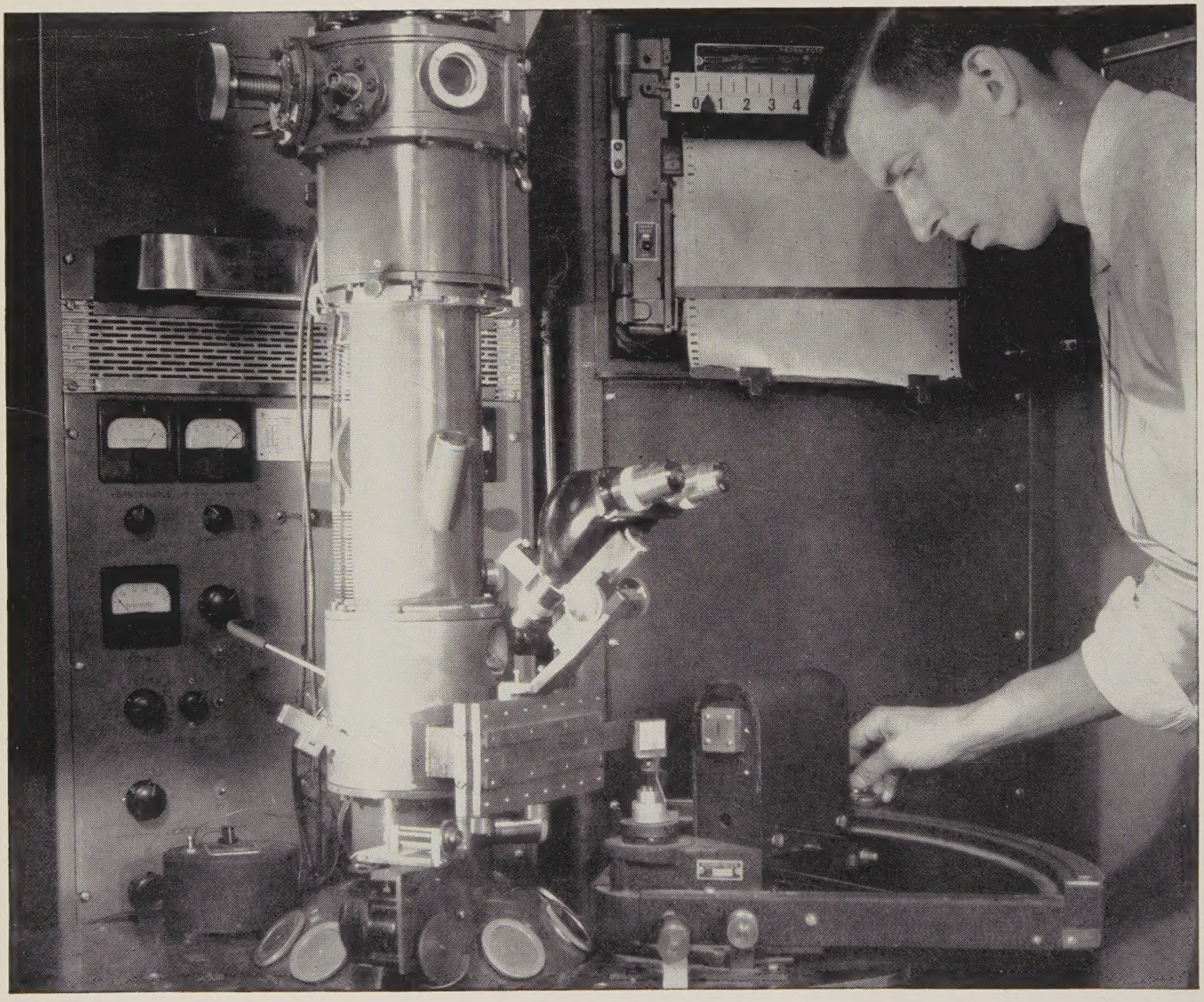

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THE ILLINOIS TECHNOGRAPH

Volume 74, Number 4 **January, 1959**

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Cover . . .

The artist, Bob Stanek, has brought attention to the feature article for this issue. The sports car is a many sided creature, and we hope to explore the topic in detail.

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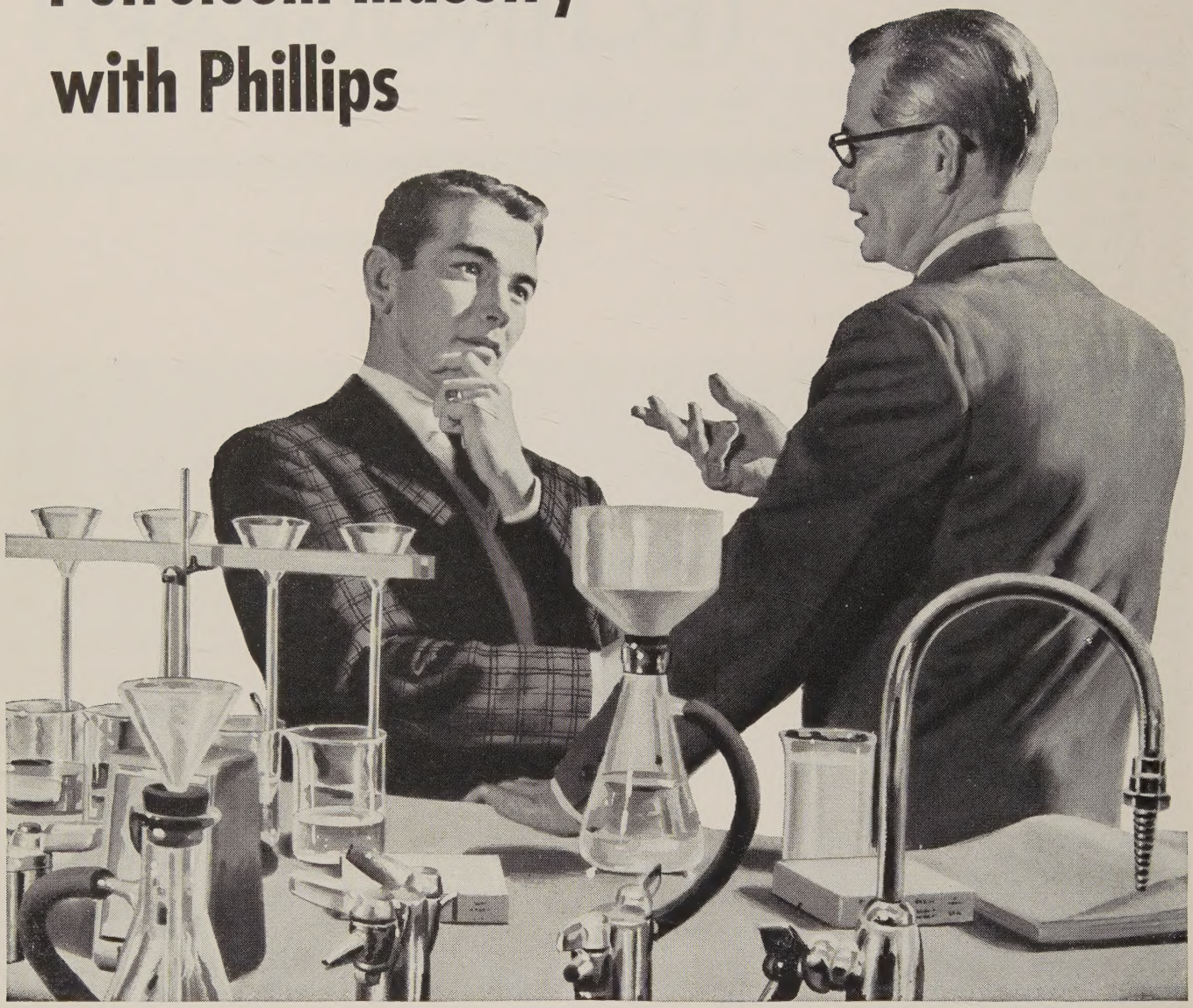

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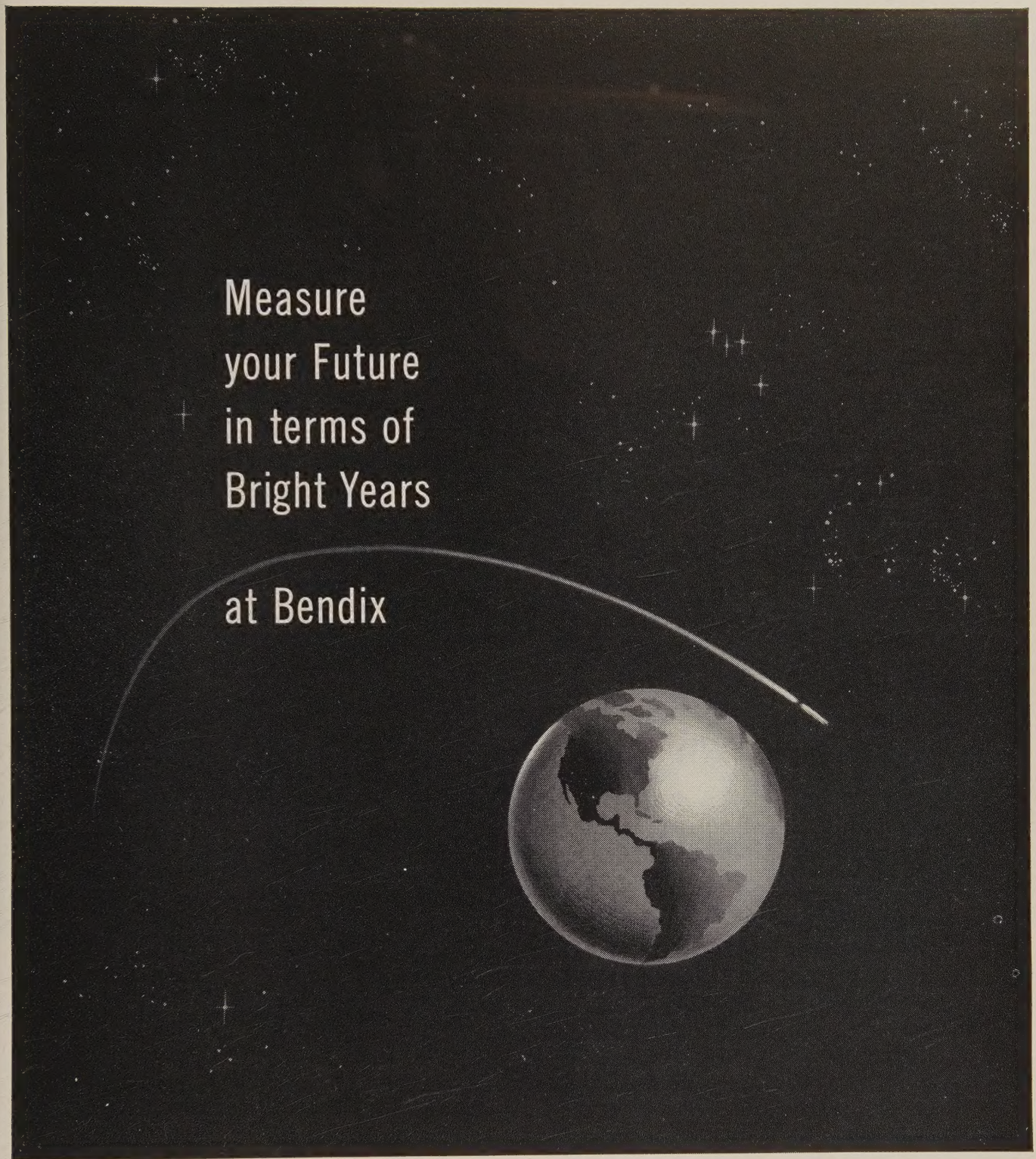

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Most important, *Samuel Zimmerman is doing exactly what he wants to be doing.* Since completion of the Westinghouse Student Training Course, he has submitted four patent disclosures, one of which resulted in a cash award; and he's now preparing two more. In addition, he has completed a year of graduate work on wave theory and analog computers toward a Master of Science degree at the University of Maryland under the Westinghouse Graduate Study Program.

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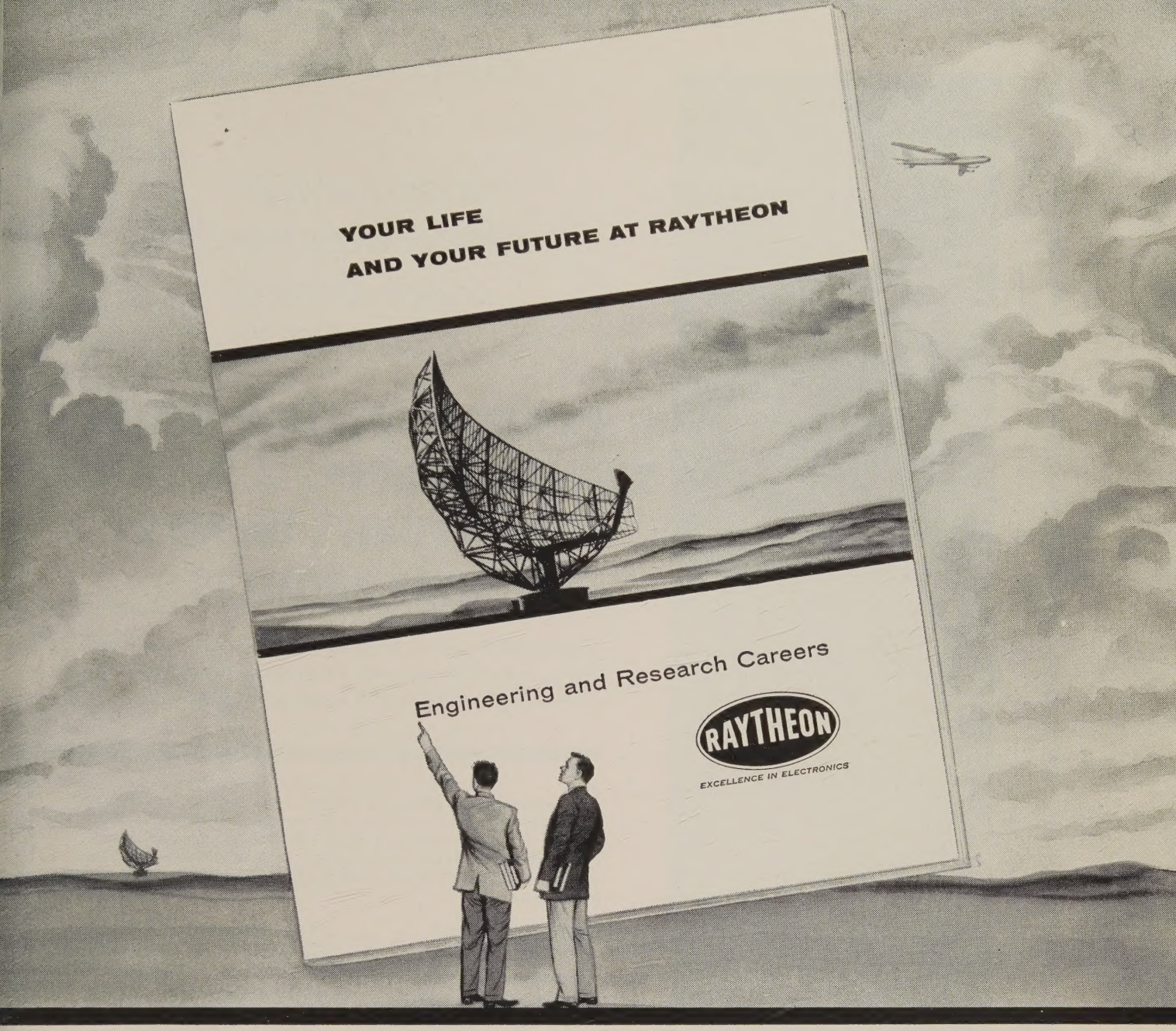

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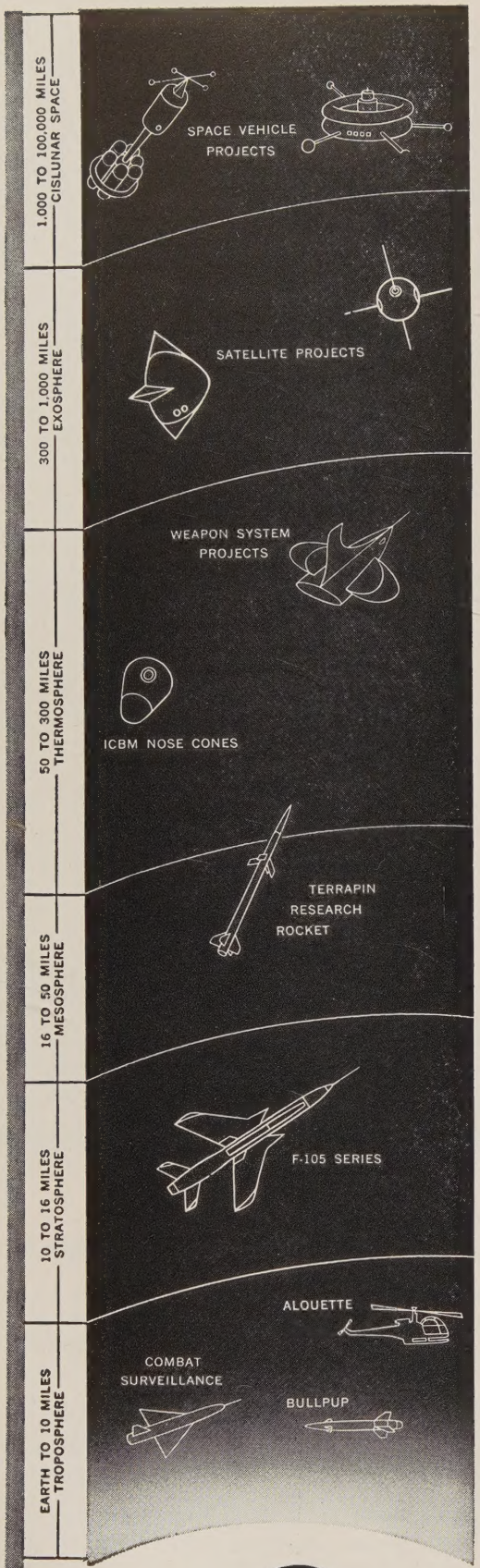

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"The aeronautical and space activities of the United States shall be conducted so as to contribute materially to one or more of the following objectives:

(1) The expansion of human knowledge of phenomena in the atmosphere and space;
(2) The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;
(3) The development and operation of vehicles capable of carrying instruments, equipment, supplies and living organisms through space;
(4) The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;
(5) The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere;
(6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by such agencies, to the civilian agency established to direct and control nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency;
(7) Cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof; and
(8) The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment..."*

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*Quoted from the National Aeronautics and Space Act of 1958.

(Positions are filled in accordance with Aeronautical Research Scientist Announcement 61E)

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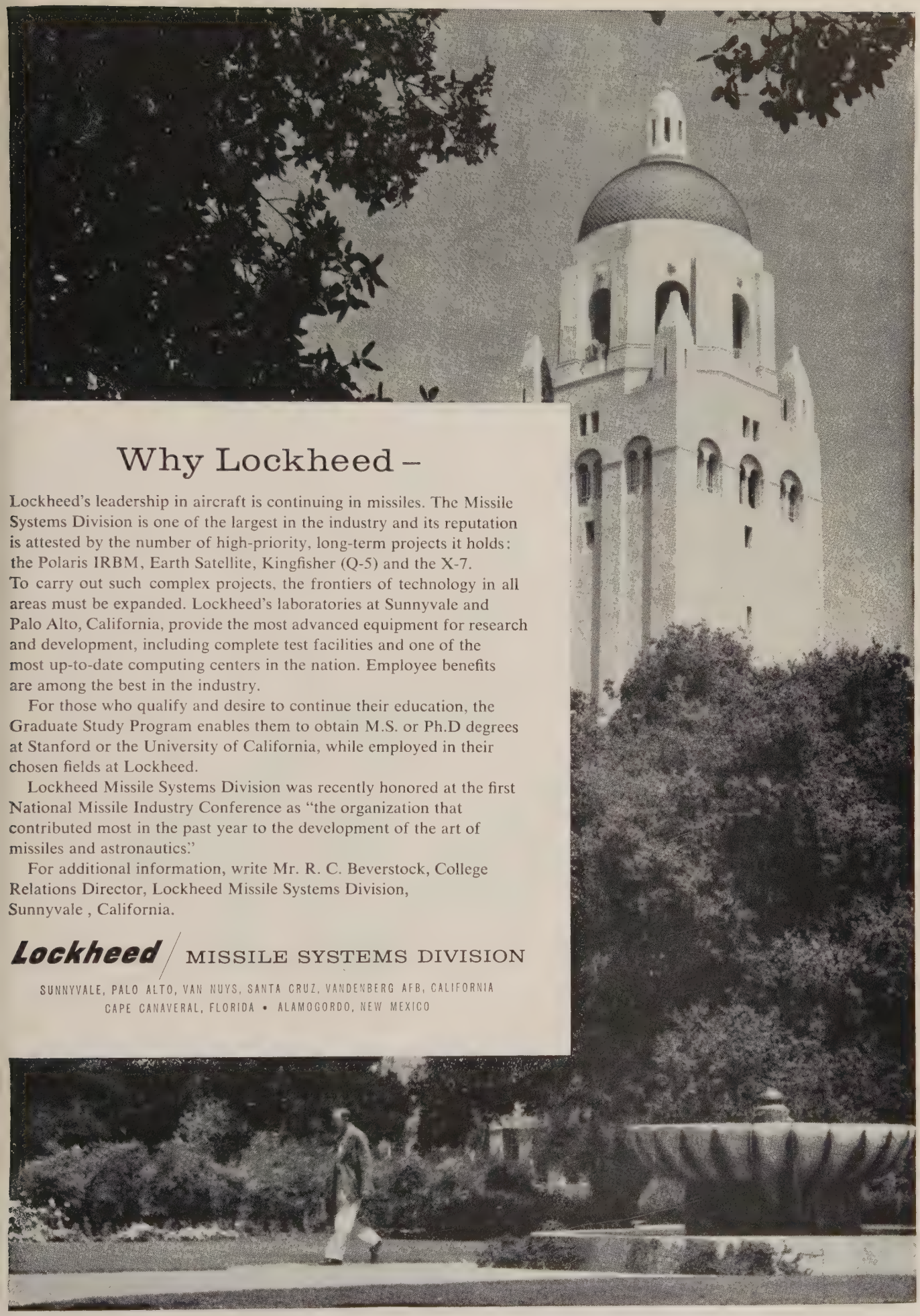

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Lockheed Missile Systems Division was recently honored at the first National Missile Industry Conference as "the organization that contributed most in the past year to the development of the art of missiles and astronautics."

For additional information, write Mr. R. C. Beverstock, College Relations Director, Lockheed Missile Systems Division, Sunnyvale , California.

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Hermann von Helmholtz...on immortality

"...what arouses our moral feeling at the thought of a future cessation of all living creation on earth, remote as this may be, is above all the question whether all life is but an aimless sport, which will ultimately fall prey to destruction by brute force. In the light of Darwin's great thoughts we begin to see that not only pleasure and joy, but also pain, struggle, and death, are the powerful means by which nature has built up her finer and more perfect forms of life. And we men know that in our intelligence, our civic order, and our morality we are living on the inheritance which our forefathers gathered for us through labor, struggle, and sacrifice; we also know that what we acquire will in like manner ennoble the lives of our descendants. Thus the individual, who works for the ideals of humanity, even if in a modest position and in a limited sphere of activity, can bear without fear the thought that the thread of his own consciousness will one day break."

—Über die Entstehung des Planetensystems, 1871

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Apathy . . .

This is to be the second of three editorials in which the engineering student will be the recipient of much comment.

I covered lethargy in the first and I will emphasize apathy in this one. Although the topics are similar they must be dealt with separately, for apathy implies indifference to what appeals to the interests while lethargy, as was said last month, is the disinclination to move. The combination of these two traits can be the ruin of an individual or an organization.

During this time of interviews companies are looking for people with interest. They ask leading questions in order to find this interest, if it exists. They ask of grades, extra-curricular activities, and previous jobs. If they find this interest in engineering and in life lacking they will not be favorably impressed.

But feigning this interest is next to impossible. After four years of one type of outlook, it is difficult to change in one half-hour interview. Even more important are the opportunities one is missing if he has no interest, for without interest life has little meaning.

There are many things to stimulate interest and many things to kill it. We have both on this campus. Our studies should be the greatest stimuli, and yet they often take the opposite role. Outside activities can be stimulating, or they can become a millstone around one's neck. And so on down the line. But with the right mixture this interest reaches a peak and life offers more than a $500.00 per month salary.

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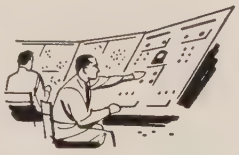

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The Second American Revolution

by Dennis E. Lantz

The first American Revoutioln was in the late 18th Century and was characterized by a great deal of social, economic, and political change. The second American Revolution has been in the mid-20th Century and been almost as important to certain portions of the country in terms of social and economic change. These latter-day revolutionists are consumers, and they have risen as individuals, but in increasing numbers, to overthrow the prevailing standards of automotive transportation.

What are these standards, both of design concept and social importance, which have been quietly but firmly set aside by a growing group of United States' automobile buyers? To answer this fully, it is necessary to go back some time and investigate these factors after the Second World War.

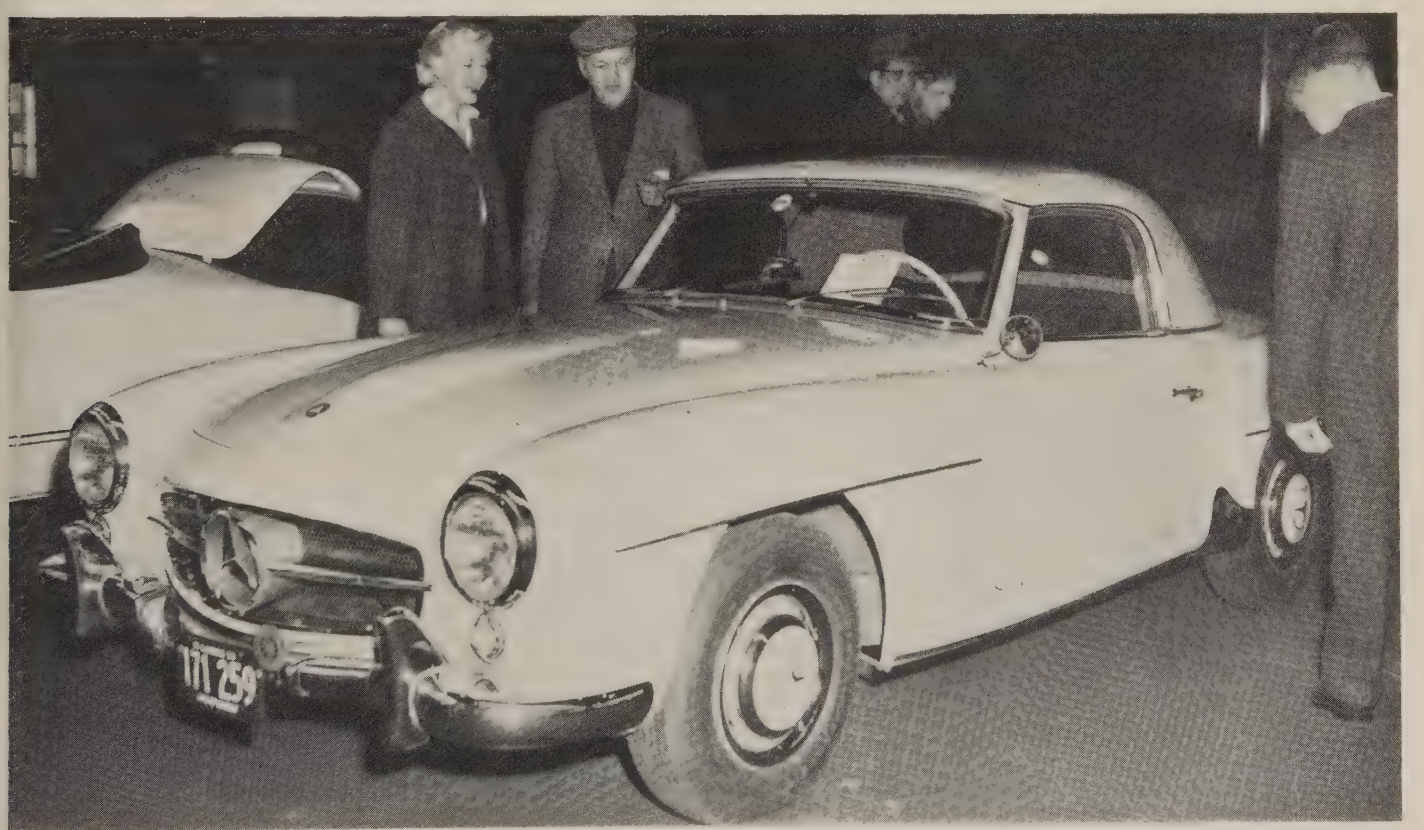
Following V-E Day and V-J Day, as the nation returned to consumer-goods production basis, two factors typified the market for durable goods. The four years on a war economy had given the people extra-ordinarily large amounts of savings, for in that time there had been nothing for them to spend their overtime swollen paychecks on. This made them willing to spend large sums on the items of which they had been deprived, and also created a demand for more comfort, convenience, and luxury than they had enjoyed during the war years. With money in their pockets, the consumers wanted to relax and enjoy the greater leisure now possible. Further, because of the great demand for durable goods and the limited, still-prewar size of production facilities, there existed a real "sellers market." Manufacturers could, and did, sell any product they could put together.

In the automotive industry, the situation was unparalleled. Forced for five years to cling to their old cars, everyone wanted a new one. Also, restricted for such a time by gasoline and tire rationing, America now blossomed into a nation on the road. Spurred on by the transportation demands of suburban living, pushed by millions of travel-wise GI's who now wanted a car, the whole country expanded its demand for automobiles.

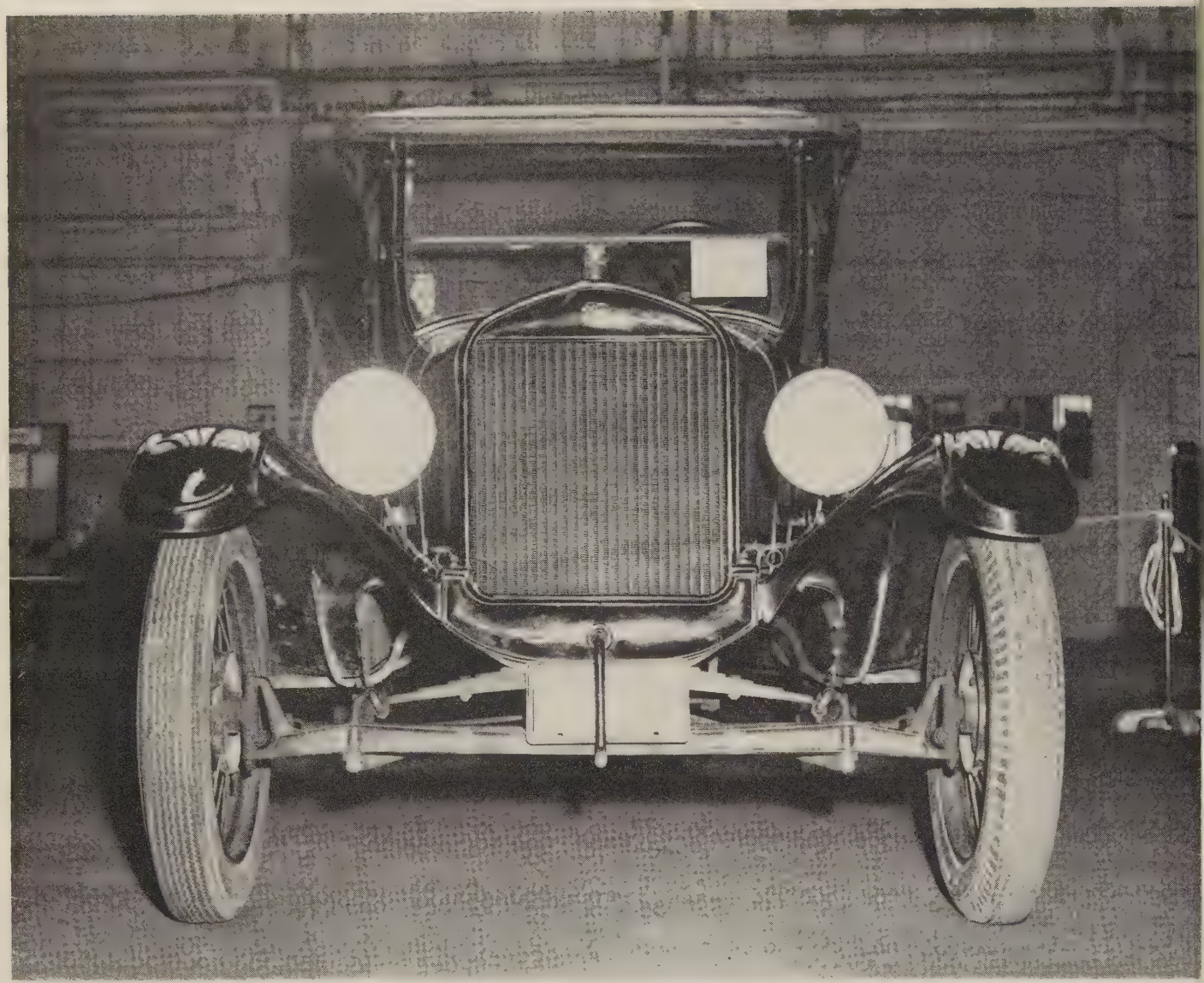
The new car had now become a social symbol. Those persons who drove new cars in 1946 and 1947 obviously knew someone—or, less obviously, passed some money under the table. The automobile had itself become an achievement. Though the market for these 1940 and 1941-designed vehicles remained strong, the auto industry sensed the end of the honeymoon and readied a change for 1949. This was the first year of widely-publicized styling triumphs, as Ford proudly pointed to its Fashion-Design Award for the 1949 model.

Soon styling, the boon of the sales department became a hydra-headed monster, the lave of finance and production. Engulfed in a philosophy of "dynamic obsolescence," the various manufacturers found themselves relying on style and "newness" in looks as the main weapon in competition. Chrysler provided the prime, painful example of this new order as their sales slumped in the early fifties, until 1954 when they hit rock-bottom in market percentage.

Up to that time, Chrysler reliance



The interest shown by these people viewing the Mercedes 790 SL represents the general trend of Americans today. Made conscious of quality and functional design by the lack of it in so many American automobiles these people have now found another market to which they may turn.



The pioneer of popular American automobiles, the Model "T" Ford, represents a certain concept in design. The large wheels and mud guards not only gave this car a distinctive look but also proved very functional on the roads of that period. How far have we come from the concept of functional design today?

had been placed on a sensible, soundly engineered piece of adequate transportation, Now, though, with generally uninspired performance on the eve of the horsepower race, and sensible design and size in the expanding era of flambuoyant styling, they were hurt. They learned. They changed. 1955 was a record year, for the industry as a whole and especially for Chrysler.

As styling grew in importance, it grew also as a sales tool. A few superficial changes in chrome marked a "new" model, and with the social magnitude of the new car as a symbol of success, meant that more frequent trades were required by the consumer to retain his automobile - based social - distinction. "Dynamic obsolescence" thus pushed sales to a new high.

All the while, as size and newness became more important, power assumed a new position. As even the banker became accustomed to the stop-light drag race, acceleration and speed assumed a new pinnacle of importance. As Ford had more "Go" in 1954, Chevrolet countered with the "Hot One" for 1955, and Plymouth dropped an even bigger V-8 into the "Fury" for 1956. Despite the despicable condition of most highways, made for 1920 speeds, horsepower topped 200, then reached 300 and continued upward. Although most drivers were completely incompetent at speed in excess of 70 mph, claims poured forth of "Stock models" that would nearly double that figure.

Even as power was skyrocketing and size ballooning, accessories became a rage. Once confined to a heater, and perhaps a radio, the accent was placed on the "Extras." Power brakes became a must, to stop 4,000 pounds of careening automobile. With 60% of this two tons on sausage-like front tires, power steering became a necessity, unless only an athlete was to park a car without winding up the steering wheel like the key on the music box. Air-conditioning, power seats, power windows, automatic transmission, more pushbuttons; all required power. From where? Why, the engine, of course, so make it bigger.

They made it bigger. It pushed an aerodynamically messy structure at 120 mph, accelerated 4000 pounds in true hot-rod fashion, and provided power thirsty accessories and extras for the owner. It would pass anything on the road, and in living room comfort. Anything, that is, but a gas station. Despite real advances in engine design, mileage dropped . . . and in the city it collapsed. The proud owner of a car with a 30% depreciation rate the first year, hated by parking lot operators, found himself getting seven and eight miles per gallon as he threaded his way through traffic jungle.

Did the consumer really want this?

(Continued on Page 30)

Above is the Merecedes 300 SL engine which puts out 240 bhp at 6100 rpm from only 182.8 cu. in. Fuel injection is used on this engine.

Back in the days of the touring car shown at the right engines such as the one just mentioned would have been considered impossible. But with consumer demand and engineering advancement we have come a long way from the family touring car.

Just how far is shown below. This fur lined floor mat represents one concept of luxury. Perhaps it is this concept that has made Detroit put out some of the products of recent years.

CATHODIC PROTECTION

by J. C. Stevenson

Each year corrosion costs the public $5.5 billion in protection and replacement costs, and even more in the indirect losses from interrupted service (*e. g.,* telephone and power failures) and resulting ill will. To help combat this problem, the University of Illinois, in 1950, established the Cathodic Protection Laboratory (CPL). Under the direction of Professor Walter H. Bruckner, the Laboratory investigates conditions under which corrosion occurs and under which it can be controlled by cathodic protection measures.

The Laboratory serves industry and the public in three ways: by disseminating technical literature, by co-operating with the Division of University Extension in presenting short courses on cathodic protection, and by seeking solutions to specific field problems.

In the last area the CPL has solved such puzzles as hydrogen embrittlement of steel and corrosion of lead cable sheath under cathodic protection conditions.

Corrosion And Cathodic Protection At A Glance

Being electrochemical in nature, anodic or electrolytic corrosion acts through a mechanism called a *corrosion cell*. In the presence of an electrolyte such as soil moisture or seat water, minute areas on metallic structures corrode by discharging corrosion currents in the form of metallic ions.

The areas undergoing corrosion are known as *anodes,* while other areas where current enters during deionization and which do not corrode are called *cathodes*. Corrosion current can flow from one structure to another or from one area to another on the same surface. Stopping corrosion current is the function of cathodic protection.

Briefly, as shown in Figure 1, cathodic protection forces a protective direct current to flow *from* a protection anode (often a bed of scrap steel or carbon rods buried near the structure to be protected) *to* the surface which needs to be defended against attack. Alternately, as illustrated in Figure 2, the external current source can be eliminated by using a *galvanic* protection anode made from a more electropositive (more easily ionized) metal than the protected structure itself. Essentially, the guardian anode forms a large corrosion cell in which the surface to be preserved acts as the cathode. Magnesium plugs recommended for protecting auto oil and cooling systems operate on the galvanic anode principle.

Economics Of Cathodic Protection

Use of either external current sources or galvanic anodes depends upon economic factors: where cost or practicability make an external source more expensive than replacing a relatively expensive metal, the galvanic method is preferred.

When used by itself on large structures such as interstate pipelines, power cables, and ships, either method of cathodic protection is uneconomical because of high protection current requirements. On such extensive structures, therefore, cathodic protection becomes economical only when used with protective coatings such as paints and coal-tars. In partially isolating the structure from the electrolyte, coatings re duce protection current requirements Coatings alone, however, are not satisfactory, for no coating has been develoed that is completely and permanently impervious to moisture. Subsequen use of the term *cathodic protection* wil automatically assume coatings are also used.

Is Cathodic Protection Successful?

Cathodic protection can protect pipelines and cables indefinitely, whereas unprotected structure may fail within one or two years after installation. The success of CP is evidenced by the fact that many of our larger cities such as New Orleans and Miami protect their underground cables and pipes with cathodic measures.

Furthermore, the U. S. Navy's "mothball" fleet was recently placed under cathodic protection, and some success has even been obtained on active ships. Possibly more significant, Loyd's of London now approves of protecting active ship hulls against corrosion through cathodic measures.

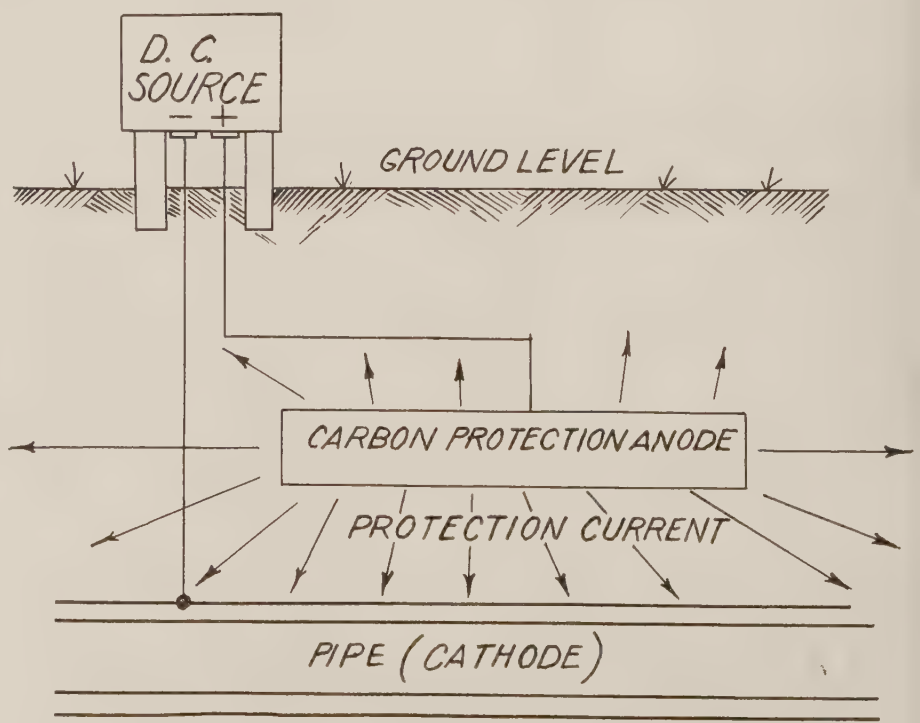


Fig. 1. Cathodic Protection System using external current source

A More Detailed Look At Corrosion And Cathodic Protection

A corrosion cell consists of an anode, a cathode, an electrolyte, a driving voltage, and a circuit-completing connection. In the case of buried pipelines and cables or ships, we find corrosion cells formed in the following manner:

1. The electrodes can result from one, or a combination ,of three conditions: a) surface characteristics (Figure 3), b) using metals with different electro-positivities for connectors, valves, and pipe sections (Figure 4), c) and the electropositive relation between structures.

2. Soil moisture or seat water serves as the electrolyte.

3. The driving voltage is derived from the difference between anode-to-solution and cathode-to-solution potentials. This voltage is similar to the electrode potential found on the familiar electromotive force table.

4. A circuit-completing connection is provided by: a) the surface itself. b) or by an electrical connection above ground.

Action of the corrosion cell, and thus of corrosion, is similar to the process of electroplating (Figures 5 and 6). In both systems, the anode undergoes corrosion through oxidation, and reduction produces a plating-out at the cathode—copper in the plating system and hydrogen in the corrosion cell. And like the plating system, a corrosion cell may be either galvanic (electrodes of dissimilar metals(or non-galvanic (electrodes of the same metal), but the type of cell does not alter the corrosion process or its prevention.

Upon looking at Figure 5, we see five rather obvious methods of preventing corrosion current flow between the two electrodes: removing any one of the five cell elements will stop the current. Though these solutions may appear obvious, their application is a problem which on occasion may prove difficult or even impossible.

For example, removing either of the electrodes or the connection between them is hardly feasible if they are parts of the same surface; this is usually the case. If, on the other hand, a connector, a valve, or a pipe section acts as one of the electrodes, we can certainly inactivate the cell by replacing the offending element with one made from the same metal as the rest of the structure. This presupposes that no electrodes are formed from surface characteristics.

As already discussed, complete isolation of the structure from the electrolyte cannot be obtained with present-day coatings. It seems as if we then have one method left—cancelling the driving voltage.

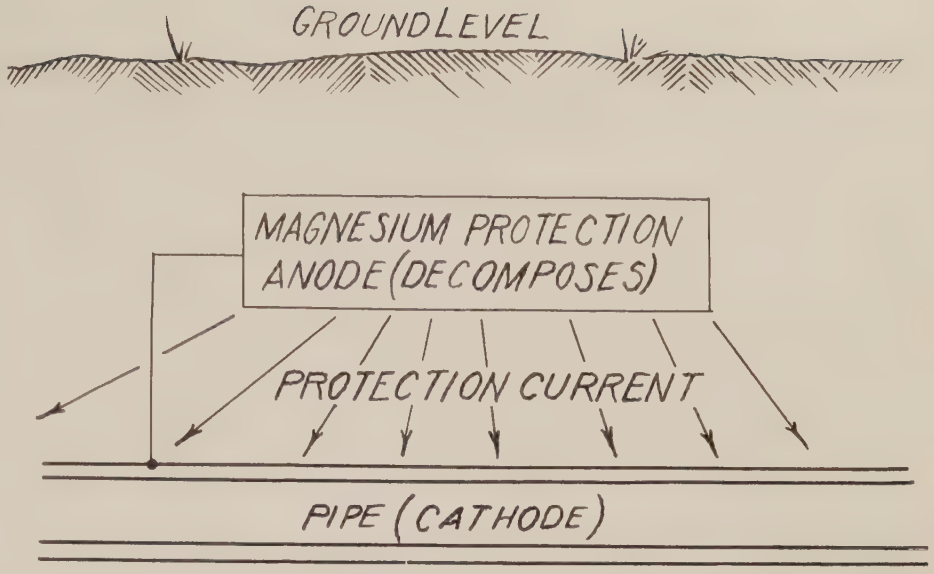


Fig. 2. Cathodic Protection System using galvanic anode. Being more electropositive than pipe, Mg oxides, thereby providing protection current.

Except for the trivial cases of connectors *et cetera,* the driving voltage cannot be physically removed, because the voltage is associated with the electrodes. But by providing a cathodic protection current, the cathode can be changed to equalize the anode and cathode voltages, thereby eliminating the driving voltage and consequently the corrosion current. In practice, however, the current is not only stopped but is also *reversed* so that the anode becomes a cathode. Hence the name, *cathodic protection.*

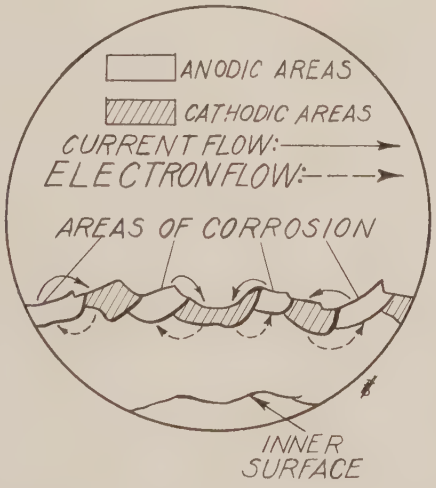


Fig. 3. Simulated microscopic side-view of a gas line showing anodic and cathodic areas on the outer surface.

Research In The Cathodic Protection Laboratory

In studying the basic phenomenon of corrosion and its prevention with cathodic protection, the CPL builds electrolytic test cells (Figure 7) which are operated from a 500 vdc, constant current power supply. Provision is made for continuously recording cell and electrode potentials with a Leeds and Northrup recording potentiometer.

When placed in the test cells, specimens are observed under controlled, simulated field conditions. With this equipment, Professor Bruckner and his colleagues can investigate the effects on corrosion as the electrolyte and amount of protection are varied.

As an example, the Laboratory, under a contract with the Commonwealth Edison Company, conducted research on the problem of lead cable sheath corrosion under cathodic protection conditions. Cable samples were placed in test cells and subjected to various environments: some of the cells used an electrolyte composed of soil saturated with such chloride solutions as NaCl, $CaCl_2$, and $MgCl_2$; others used solutions of KOH-KCl and NaOH-NaCl; and still others employed a soil extract to which chlorides had been added. Protection currents were applied both continuously and intermittently and in various densities. Among numerous conclusions, the CPL determined that *complete* protection could be obtained only with a *constant* current source—a source not normally found in the field. The same general procedure is now being used for investigating two problems for the Office of Naval Research.

Conditions under which active ships can be completely protected against corrosion poses one of the two problems now being examined by the Laboratory. Special test calls have been set up with simulated sea water electrolytes, and the metallic specimens are rotated by

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STEREOPHONIC DISC RECORDING

Realism in Reproduction

by James Smith, E.E. '59

Stereophonic sound is the highest degree of realism in sound reproduction. Stereophonic records and phonographs are threatening to take over the position held by monaural high-fidelity in recent years. However, as in any new industry, there are still some problems yet to be solved. As a result, there has been a general lull on the commercial market while people wait for news of further developments either for or against stereophonic sound.

One of the biggest problems in this new industry is in the method of recording stereophonic sound on records. Quite a few methods of recording have been proposed. Bell Telephone Laboratories obtained the first United States patent on a method of stereo disc recording in 1936. Two systems were demonstrated at the New York High Fidelity Show in October, 1957. Both systems were well received and several industrial committees held meetings to decide on a system to adopt as a standard.

We will examine four of the methods of stereo disc recording and present some of the advantages and disadvantages of each system. The four methods which we will discuss are the 45-45 system, the vertical-lateral system, the Cook system, and the Minter Stereo Disc or M.S.D. system.

The 45-45 system is the system adopted by the Radio Industry Association of America, and is the current standard. In fig. 1-c,d,e, it can be seen that the two channels are recorded at a 45 degree angle to the surface of the record. In fig. 1-c the right channel is held constant and the motion indicated corresponds to the left channel. In a similar manner fig. 1-d shows motion in the right channel only. Fig. 1-e indicates motion in both channels together.

Since these two movements occur at 90 degree angles to each other, the crosstalk between channels is theoretically zero. A 45-45 disc is found to have a separation of at least 20 decibels. The playing time will be shorter than the conventional LP, but using the proper combination of automatic margin and automatic depth control makes it possible to increase the playing time up to about the same as a standard LP.

This system is partially compatible with the monaural system. A monaural record can be played with a special 45-45 stereo cartridge. However, a monaural cartridge is used to play a stereo record, the record will be damaged because the standard pickups do not have freedom of movement in the vertical direction. Another disadvantage of the system is that vertical rumble in the turntable will produce undesirable disturbances.

There are two methods of correction for this problem. One is to reduce the rumble at its source with improved turntable design. The other method of reducing vertical rumble disturbances is to reduce the pickup sensitivity to low frequency vertical motion.

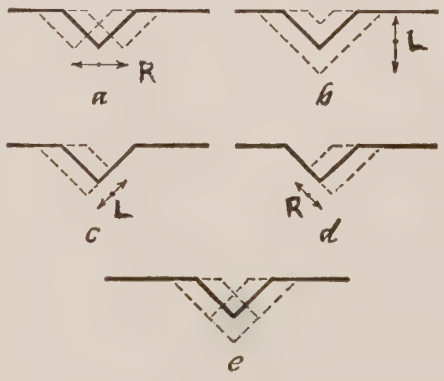


Fig. 1. Some of the possible groove displacements in phonograph records: a, lateral; b, vertical; c, d and e, 45/45 stereo.

It is apparent, therefore, that while the 45-45 system does accomplish stereophonic sound reproduction, it is far from ideal.

The second system which we will discuss is the vertical-lateral system. This was proposed as a standard by London Records.

This method is quite similar to the 45-45 system since the motion of the groove occurs in two directions at 90 degree angles to each other. The two channels of this system are shown separately in fig. 1-a and b. One channel is recorded in a lateral or horizontal direction; the other channel is recorded in the vertical direction.

A 45-45 pickup can be modified electrically to play a vertical-lateral record stereophonically. The playing time of the vertical-lateral record is shorter than that of a standard LP, but automatic margin and automatic depth control can increase the playing time to about the same time as that of a standard LP.

The compatability of the vertical-lateral system is very poor. A monaural pickup on a vertical-lateral record will only reproduce one channel and will severely damage the other channel. A special vertical-lateral pickup will reproduce all the vertical noise in one channel and the other channel will reproduce the sound.

Vertical rumble is also a problem with this system, and is further complicated by the fact that it is confined to one channel. Since reduction of low frequency response of either channel cannot be employed in a true hi-fi sys-

tem, all improvement must be done to the turntable design.

This combination of shortcomings of the vertical-lateral system has eliminated it from use in this country. However, it is being used to some extent in Europe, and further developments will be watched closely.

A third system of stereo disk recording was invented in 1952 by Dr. Emory Cook. It consists of two separate grooves spaced about 1½ inches apart and requires a special double arm with two standard monaural pickups. One big advantage of the Cook system is that the vertical rumble problem is eliminated. However, this method presents several other problems which are not found in the other systems. It has less than half the playing time compared to the standard LP. A far greater disadvantage is that the spacing between groove pairs is not always maintained accurately in production of pressings. This results in groove jumping so that the two channels are no longer "in sync." There is also a problem in starting the two channels exactly "in sync." No answers have been found for these problems so this system is not currently used in the United States.

The fourth and last system to be discussed is one of the newest methods of stereo disc recording. It is called the Minter Stereo Disc or M.S.D. system, and was first demonstrated in December of 1957. The stereophonic properties of these discs are obtained from a supersonic frequency modulated carrier wave recorded laterally in the groove together with the ordinary lateral microgroove recording.

One channel is the ordinary lateral channel found in a regular monaural record. The second channel is recorded by frenquency modulating a 25 kc. supersonic carrier. The carrier, recorded along with the first channel, is swung from 20 to 30 kc. to get a 5 kc. deviation.

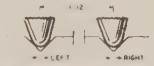
They are played back with a conventional monaural cartridge which must have good response up to 30 kc. An ordinary 1 mil. stylus may be used, but a .5 mil stylus is preferred. Also required is a three tube detector-pre-amplifier in place of a second conventional pre-amp that would be necessary with any of the other systems.

When the stereo disc is played back on a monaural system, the combined output of both channels will be heard. This is possible since the two original channels are added together vectorally to form the one channel recorded directly on the disc. The original channels are subtracted vectorally to produce the second stereo channel that is used to modulate the 25 kc. carrier recorded on the disc. Playback circuits combine these sum and difference channels in such a way as to recover the two original stereo channels.

It can be seen that the M.S.D. system is fully compatible with monaural. It does not require a special cartridge, although it does require a good monaural cartridge. The playing time is not reduced appreciably because the groove modulation amplitude is only 20 millionths of an inch. Vertical rumble is also eliminated with this system because a monaural pickup is used.

The M.S.D. system, although the newest of the systems discussed, appears to have some definite advantages.

Now that we have examined each system individually, let us go back and summarize the results we have obtained. The characteristics of the four systems are tabulated in fig. 2 for easy reference.

NAME	SECTION OF GROOVE	COMPATIBILITY (with monaural)	PICKUP	PLAYING TIME (compared to LP's)	VERTICAL RUMBLE SUSCEPTIBILITY
45-45		Yes*	Special	Shorter	Yes*
Vertical-Lateral		No	Special	Shorter	Yes
Cook		Yes*	Standard	Less than half	No
MSD		Yes	Standard*	Same*	No

*With qualifications see text

Fig. 2. Characteristics of stereo disc recording methods

Probably the most important property of stereo recording systems is compatibility with monaural systems. The 45-45 system has a qualified yes because, while it can play monaural, a stereo record will be damaged if played with a monaural pickup. The vertical-lateral system is incompatible with monaural because the vertical channel of a stereo pickup reproduces all the vertical rumble in a monaural record, and the vertical channel of a stereo disc is damaged if played with a monaural pickup. The Cook system can be compatible with monaural if one of the pickups can be lifted from the playing surface. However, a single monaural pickup on a Cook disc can only play one channel at a time. The M.S.D. system is the only one of the four methods discussed which is fully compatible with monaural.

The pickup required for the system is another characteristic which is of interest. The 45-45 and the vertical-lateral system require a special pickup. The Cook system simply needs two ordinary monaural cartridges. The M.S.D. system needs one ordinary monaural cartridge but with good response up to 30 kc.

The playing time of the first two systems is slightly shorter than that of the standard LP. The Cook system is slightly shorter than that of the standard LP. The Cook system has less than half the standard playing time. The M.S.D. has approximateily the same playing time as a standard LP.

The last characteristic which we will compare is the vertical rumble susceptibility. The 45-45 and vertical-lateral systems are both susceptible to this rumble. However, it is much easier to eliminate this problem in the 45-45 than in the vertical-lateral system. The Cook and M.S.D. system are not sensitive to vertical motion, therefore do not have this problem.

From this discussion, it is apparent that each system has some advantages. While the 45-45 system is the present standard of the industry, it is not necessarily destined to remain in this position. An analogy can be made to the color TV industry. The C.B.S. system of non-compatible color was adopted as the standard by the F.C.C. in 1951. However, in 1953, the F.C.C. switched to another more perfected method—the N.T.S.C. or National Television Systems Committee method. It is highly possible that the same thing may occur in stereo disc recording.

Possibly one of the other methods described will be perfected to the point where it will be instituted as the commercial standard. Or it is equally possible that some other new method will appear that will be superior to any of the present systems. We can only wait while the engineers and technicians are working to make stereophonic sound not only realizable but practical.

RUNNING SCARED

or the Advantages of Insecurity

by Everett P. Partridge

This paper was given by Dr. Everett P. Partridge, at one time the associate editor of Industrial and Engineering Chemistry and since 1950 Director of the Hall Laboratories Division of Hagan Chemicals & Controls, Inc.

* * *

As you go about prospecting for a job, many interviewers will inquire, "What are you?" What they mean of course, is, "Have you completed certain prescribed courses in a formal curriculum which will lead people to think of you as a chemical engineer—or a mechanical or an electrical engineer or a chemist or a nuclear physicist?"

A much more significant question is, "What are you trying to become?" This is important, because all your life you will keep on becoming.

In doing this, you of the present generation will have to struggle against a particularly serious handicap. I don't mean a recession in business, for the economists' graphs for the future all zoom upward. By 1965 we shall have 25 million more people, $100 million more gross national product, 115 million more kilowatts than we had in 1955.

Any one of you can have your choice of at least ten jobs now and for some years to come.

Your *real* income will be slightly more than twice mine when I got out of college in 1925.

You can expect your wife to work, too, so that your combined income will allow you to have two cars, even if no babies.

You need take no thought for the future, for you will be protected by:

1. Medical, surgical and hospitalization insurance
2. Unemployment insurance
3. Severance pay
4. Profit-sharing
5. Pension
6. Social Security

You have it made. Why worry about anything?

This is a truly serious handicap. I think you go farther and have more fun if you run scared.

By running scared I don't mean a state of panic. I do mean a state of mind which keeps saying to others of your own performance, "I should have thought of that," instead of "Well, you didn't tell me to."

If you do accept responsibility, inevitably you will feel the weight of it on your mind. You will worry about making the right decision, you will wonder afterwards if you did. You will feel uncomfortable.

Nobody likes to be uncomfortable. So the majority of men, including, unfortunately, some who call themselves engineers, seek security rather than responsibility. Their ideal job is one where everything that goes well is obviously a result of their good work, but everything that goes wrong is the fault of someone else—an incompetent boss or a stupid assistant.

Perhaps you have seen the early stages of this mental disease already in some classmate or even—perish the thought—in yourself. Whose responsibility was it that you didn't get much out of that course in English or differential equations or heat transfer? Was it actually the fault of that lousy instructor . . . or of the classmate who wouldn't lend you his notebook the night before the exam? Or could it just possibly have been your own shying away from the responsibility of disciplining your own mind to work at the problem day after day?

When I was a student chemical engineer at Syracuse University, one of the courses required in the senior year was economics. It was taught by a professor from the College of Business Administration who came over to the College of Applied Science on Monday, Wednesday and Friday at 10 a.m. for an hour that he must have dreaded.

As engineers we were proud of our carefully nurtured cult of uncouthness. We also looked down on Business Administration because that was where all the boys who flunked out of engineering went. So we had the usual unthinking undergraduate fun with this utterly humorless professor of economics.

One item was the fictitious student we registered under a name I wish I could remember. Anyway, every time the solemn professor called the roll, there was laughter. After some five weeks during which we used all the usual ruses to report our imaginary classmate present—in the infirmary with sleeping sickness, or on his honeymoon—the professor realized that he had been taken. He stormed down to the Dean, shouted that he had never been so insulted in his life and refused ever to teach that course in economics again.

We barely cared. What did economics have to do with engineering anyway? We rather congratulated ourselves on having eliminated a dusty nuisance from our solid 8 a.m. to 5 p.m. schedule. I suspect, however, that many classmates have had to study economics quite a bit over the thirty years since.

I have a responsibility right here that I want to fulfill. If I fail, I could say, "Well, after all, what can you expect of young folks today? They have been spoiled by lack of discipline at home and in school. They just don't give a damn." What I actually should say to myself would be something like this, "Partridge, why didn't you get across to those students? Perhaps you weren't

(Continued on Page 22)

A darning needle or grain of sand?

E/C^2?

A singularity in a field?

A ratio of accelerations?

How is it held together?

Is there a region of anti-matter extant in the cosmos?

The nature of matter is important to Allison because energy conversion is our business and matter is convertible to energy. Thus, we have a deep and continuing interest in matter in all its forms.

Basic to our business is an intimate knowledge of every form of matter — solid, liquid, gaseous. We search for this knowledge to increase the effectiveness with which we accomplish our mission — exploring the needs of advanced propulsion and weapons systems.

Want to know about YOUR opportunities on the Allison Engineering Team? Write: Mr. R. C. Smith, College Relations, Personnel Dept.

Energy conversion is our business

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Division of General Motors,
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using their language. Perhaps you could not get inside their minds."

That attitude might well be considered by some instructors who take their own responsibilities too lightly.

Because I feared I might not be tuned to the proper wave length for reception by you, I asked the last three recruits to our training course for field engineering services to sit down with me one afternoon some weeks ago. They suggested several little messages I might transmit. They say that out on the job:

1. You can't just "cut classes" when you feel like it.
2. You can't depend on your roommate to carry you through some problem on which you are stuck.
3. Everything isn't in the books.
4. Don't expect things to happen overnight.
5. A training program isn't just a necessary evil to be gotten over as quickly and painlessly as possible.
6. You don't have to compensate for your inferiority complex by telling the boss the first week what to do and how to do it.
7. The shortage of engineers doesn't guarantee a good, continuing job with a future.
8. You have to assume responsibility.

How much can be expected of an engineer is illustrated by the experience of a man, now retired, who worked for many years for one of the large steel mills in the Pittsburgh area. As a young engineer in the utilities department, he was made responsible for all plant water. Full of vim, he checked the entire complicated distribution system, discovering, to his horror, that if one pump taking water from the river went out of service, the entire plant operation must inevitably be shut down. He convinced his boss and his boss's boss and so on all the way up the line to the president of the company that a second big pump should be purchased. But the president took a long look at the cost and said, "No." Not many months later the critical pump failed. The mill shut down.

The young engineer was promptly called to the president's office to explain why the water supply had failed. As tactfully as he could, he pointed out that he had warned against the precarious dependence on one pump, had even argued with the president himself for the purchase of a spare, and could therefore scarcely be blamed for the catastrophe. "Yes," roared the president, "But if we needed that extra pump, it was your job to convince me!"

When I stated my thesis that you go farther and have more fun if you run scared than if you feel secure, I meant both points. Let's consider why you go farther.

Here is an equation attributed to Dan McQuaid, who calls himself the cowboy engineer:

$$V = A - S$$

In words this reads: "The value of any position is equal to the ability of the individual to produce, minus supervision."

Strangely enough, industry is always looking for men to whom it can pay more money. Such men must have a value for A — S that causes them to stand out from their fellows. Sometimes an individual who does not have exceptional ability to produce goes ahead of an inherently more able man simply because the average fellow is a self-starter who runs scared, while the more able fellow requires so much supervision that he is actually less valuable.

Do you know what happens then, even in some cases after the supervisor or manager has carefully explained the whole situation? The inherently more able man who has been bypassed goes around muttering under his breath about eager beavers who spend all their time trying to make themselves look good to the boss!

My second point was that it is more fun to run scared than to feel secure. Let's not interpret that as a plea that you develop ulcers at thirty. But if you feel responsible, you will feel that you really count for something. That is a way that most of us human beings need to feel.

If you feel responsible, it helps to fix your thoughts on the thing for which you are responsible, which makes for mental health. The man who shuns responsibility easily gets to thinking about himself more and more, so that he enjoys life less and less.

It has always seemed to me that there was an impressive psychological truth behind the Biblical statement that, "He who loses his life shall gain it." I would paraphrase this as: "He who loses himself so completely in living that he identifies himself with what he is trying to accomplish, really lives."

This can be an even greater satisfaction than having as many Cadillacs as Elvis the Pelvis.

Long before this, you have realized that my title was obviously created to stir your curiosity. Long before this you may have begun to wonder when I would quit beating to death this idea of reaching out for responsibility. The answer is: in about four seconds. But first let me urge that you never utter the famous phrase, "Let George do it," unless your name is George.

TECHNOCRAKS

Prof.: "What is an engineer?"

Student: A person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude inate strings of incomprehensible formulae calculated with micromatic precision from vague assumptions which are based on debatable figures taken from inconclusive experiments carried out with instruments of problematical accuracy by persons of doubtful reliability and questionable mentality for the avowed purpose of annoying and confounding a hopeless chimerical group of fanatics referred to all too frequently as Engineers.

* * *

Last night I held a little hand,
So dainty and so sweet,
I thought my heart would surely break.
So wildly did it beat.
No other hand in all the world,
Can greater solace bring
Than the sweet hand I held last night—
Four aces and a king.

* * *

Corporal Funston hurried into the headquarters of Colonel Stuffit.

"Colonel," he said, "I have a letter from the men at Fort Wooster in the Sahara. They say they are out of water and that we must aid them."

"Certainly, certainly," replied the Colonel. "Something will be done within the week."

"No, sir. We must get water to them at once."

"Very well, Funston, there is a caravan passing that way tomorrow. We'll have them supply the water."

"Sir we must send the water sooner."

"Really, Funston, they can't be that bad off. Surely they can wait 'till tomorrow for water."

"I thought so, too, sir. Then I noticed that the stamp on the letter was attached with a paper clip."

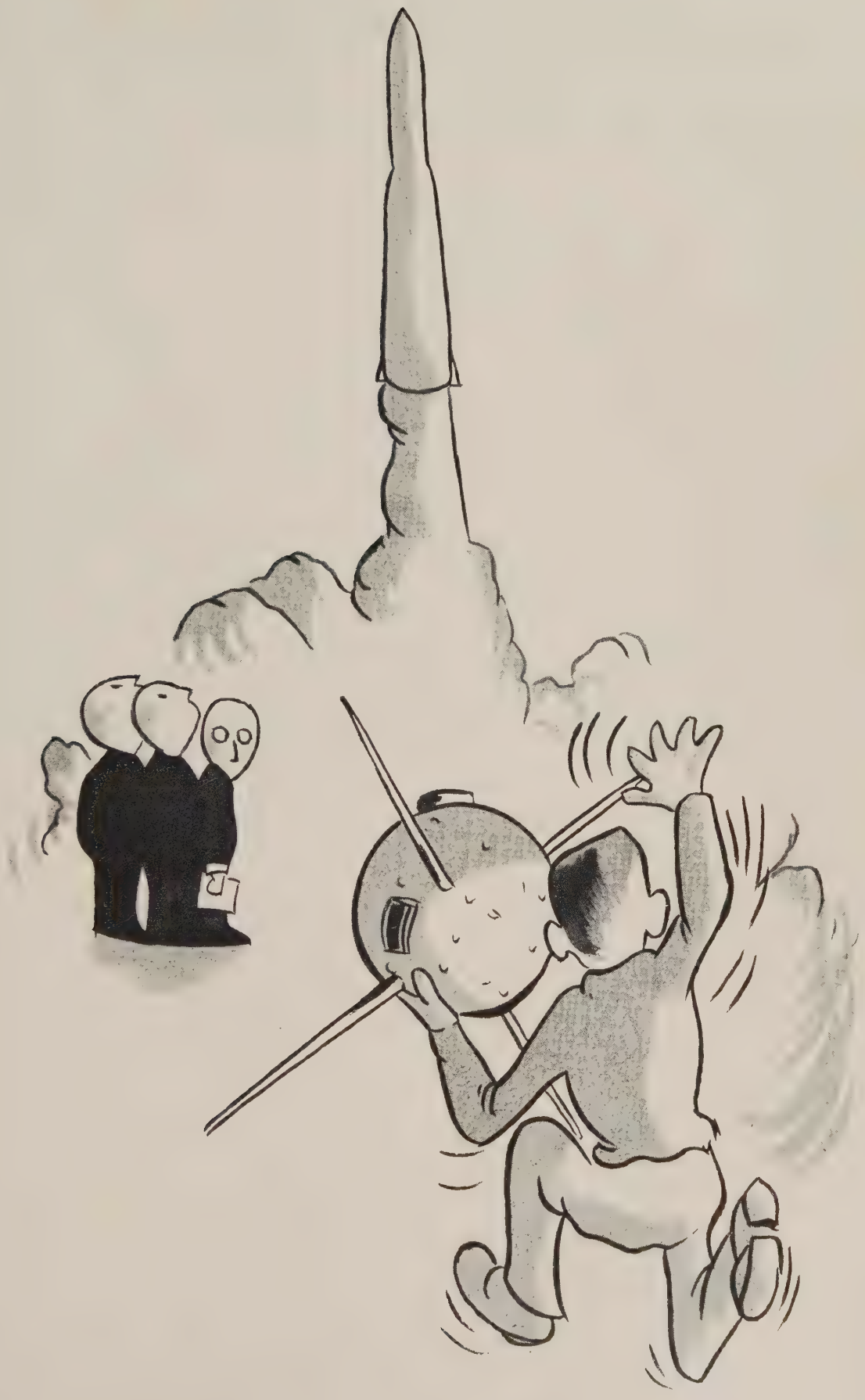
* * *

Two Indians had watched with much interest the building of a lighthouse off the rocky west coast. When it finally was completed they sat and watched it every night. A thick fog came rolling in one night and the siren blew continuously.

"Ugh," grunted one Indian to the other. "Light shine—bell ring—horn blow—but fog come just the same."

* * *

"Halt! Who goes there?"
"British soldiers."
"Pass British soldiers."
"Halt! Who goes there?"
"French soldiers."
"Pass French soldiers."
"Halt! Who goes there?"
"Who in hell wants to know?"
"Pass, Yanks."



DEVELOPMENT AND LIMITATIONS OF ROCKETS AND SPACE TRAVEL

by William G. Huley

The significantly important field of rocketry can perhaps be best divided into three main areas of chronological development. Logically then, these areas would consist of the past, the present, and the future.

Since the beginning of man's existence on earth, he has looked towards the stars and dreamt what they might behold. Throughout these thousands of years, the world has moved slowly, but steadily, toward the day when man shall at last break the gravitational bonds of the earth. Today, the dream is virtually a reality because of the accelerated development of rockets. For it will be by rocket, either chemically-fueled or some form of atomic-propulsion, that man will move outward into space.

In order to more fully understand the results of present day rocket technology, it is perhaps best that the evolution of rocketry be described.

The development and use of the rocket was first known to the Chinese long before the Christian era. At first the use of this new device was employed merely in the form of fireworks. Soon, the Chinese powder rocket invention became known to other peoples of the world, especially the Persians, Arabians, and Greeks. The rocket had its first practical application when it was used as a signaling device between Army camps in the field. More significant use was employed in the form of incendiary or "fire arrows." Although these devices inflicted little, if any, damage in warfare, they proved to be by fare more effective as a terrorizing agent. History familiar to all of us illustrates a significant use of this device in the invasion of Fort McHenry by the British when "The Star Spangled Banner," written in the midst of battle, vividly described the familiar "rockets red glare."

It was not until the beginning of the twentieth century that rockets received their first accelerated stage of development. The first important contribution in this field was made by William Hale, who is credited with replacing the common stabilizing stick with curved veins, giving a spin to the rocket and thereby providing directional stability. Recognized in the field of this accelerated development were other men such as Dr. Robert Goddard of Clark University. It was Goddard who did extensive research on modern rockets shortly before and during World War I. At this same time, Herman Oberth was credited with providing some of the first sound research in rocketry.

With the climax of the first World War, little, if any, investigations were conducted, but as the years shortly before World War II approached and the nations of Europe sensed the tremor of oncoming war, several nations (namely Germany, Russia, and England) renewed research and development activities. Without a doubt, the Germans were the most advanced as evidenced by their development of the V-1 buzz bomb and V-2 rocket during the War. Actually the V-1 was not truly a rocket vehicle but rather a pilotless aircraft propelled by a pulse jet engine. Here again—just as thousands of years before when the Chinese, Persians, Arabians and Greeks first used rockets—it is important to note the effectiveness of this V-1 buzz bomb. Although the unit inflicted relatively little damage, the realization that a bomb could be sent across the English channel provided more damaging results psychologically than could the limited explosiveness of the warhead itself. It is interesting to note the relatively crude means, by today's standards, that the V-1 bomb was guided to its target. The rockets were launched manually and rose to an altitude as predetermined by a barometric device, the direction being guided solely by a spinning gyro. At a predetermined time, the engine stopped and the V-1 dived into the ground. As time went by, the British fighter pilots developed great skill in shooting down the V-1's and in some instances actually managed to down the aircraft by flying alongside and upsetting its flight course by flipping the wings of the buzz bomb with those of their own. It wasn't too long until the Germans caught onto this trick and began installing contact detonators on the wings, thereby destroying any aircraft that came within its contact. Of the 8,070 bombs launched against England, some 2,420 got through to the London area.

The first important step in modern missiles began with the German-built V-2 rocket. This vehicle was a massive unit, 46 feet long, five feet in diameter and weighing twelve tons. Although it was used to some extent against England, its results did not even measure up to those of the V-1 because of its unreliability and complexity.

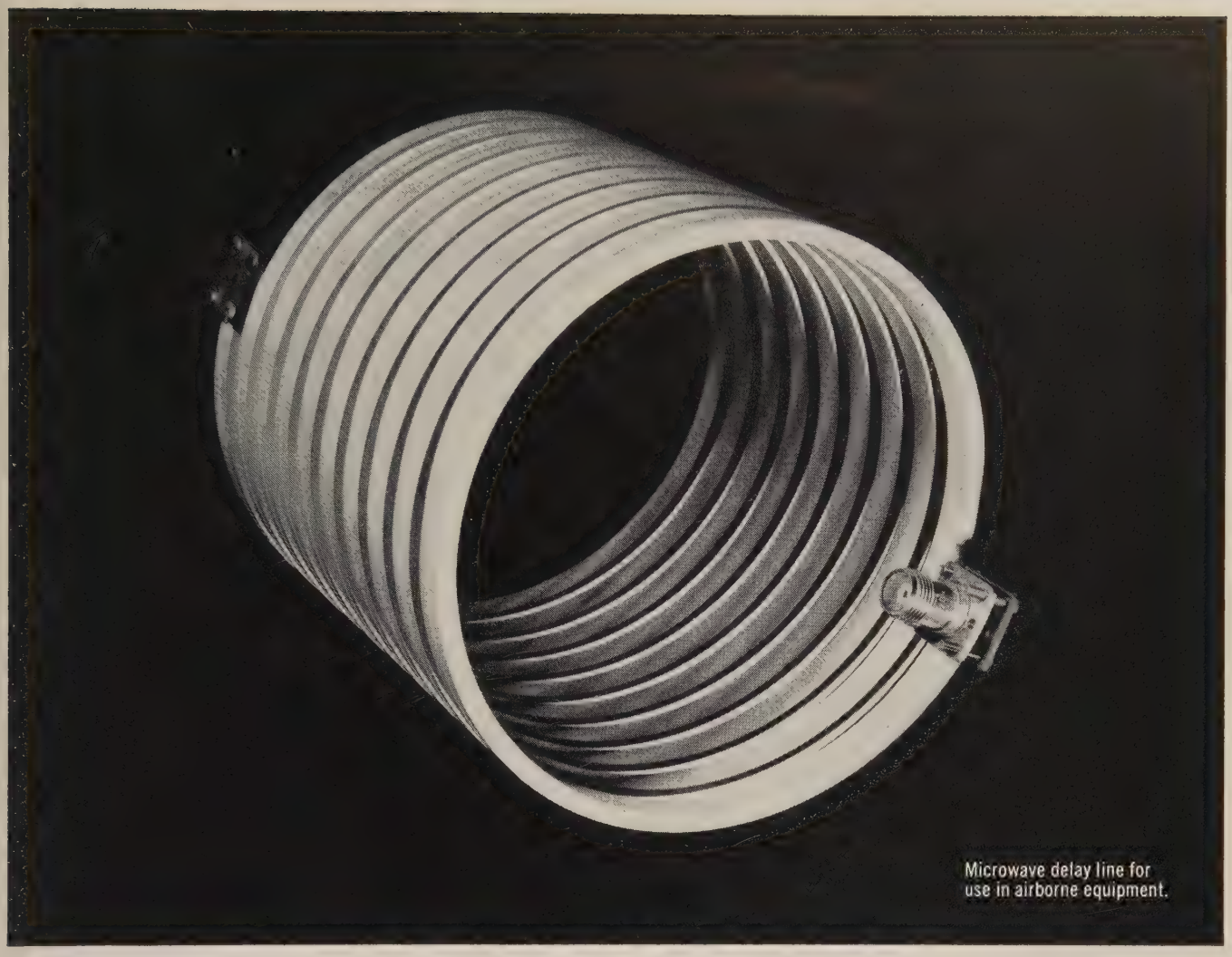
Although the jet-type engine does not categorically belong in the realm of rockets, it would be a noticeable omission if recognition of this important member of propulsion systems were not given. For the most part, development of the jet engine is credited to an Englishman, R.A.F. Captain Frank Whittle, who was the first to obtain a patent in 1930. However, it must be observed with due regard that the Germans had also developed jet engines during the 1930s.

The impact of modern rocket technology during World War II saw widespread use in other fields of application. The bazooka with its light weight and extreme mobility provided a potent weapon in anti-tank warfare. During the latter part of the War, the barrage rocket was used extensively in extending the mobility of short-range artillery warfare.

Two other developments came virtually too late to see extensive use during the war. One of these, the Jato unit, was used on aircrafts as an added propulsion booster for short-range takeoffs. The term, Jato (jet assist takeoff), is actually misnamed Rato (rocket assist takeoff) is technically correct. In principle, the unit is actually a rocket rather than a jet.

The second of these developments late in World War II was the rocket principle as applied to recoiless guns. This application enabled large calibre guns to be mounted on small, extremely mobile vehicles such as jeeps.

(Continued on Page 35)



Microwave delay line for use in airborne equipment.

MICROWAVE RESEARCH

The expanding role of electronic equipment in modern military operations has given high priority to microwave research. No field today offers greater challenge to the scientist and engineer.

In support of current electronic countermeasures programs and in anticipation of future systems requirements, Ramo-Wooldridge Division is engaged in microwave research to develop new techniques and to refine conventional components.

Research is under way at Ramo-Wooldridge for new methods and new designs to reduce substantially the over-all size, weight and complexity of electronic equipment for both airborne and ground-based uses.

For example, the low-loss delay line in the photograph above was designed, developed and manufactured by Ramo-Wooldridge for use in airborne equipment. Packaged for use in the system for which it was designed, this miniature ceramic unit weighs less than two pounds. It replaces a component which weighed more than twenty pounds and occupied more than five times as much volume.

Special opportunities exist for those with qualified experience in microwave research—in technique evaluation, component development, and design of such systems equipment—at Ramo-Wooldridge.

Engineers and scientists are invited to explore openings at Ramo-Wooldridge in:

- Electronic Reconnaissance and Countermeasure Systems
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- Air Navigation and Traffic Control
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2-$25 Awards

Two cash awards of $25 each will be awarded to the author of the best TECHNOGRAPH staff article and the best non-staff article submitted to the ILLINOIS TECHNOGRAPH.

Rules:

1. Articles must be submitted by the author not later than April 1, 1959.
2. It must not have been previously published.
3. It must pertain to engineering in some way.
4. All articles must be doublespaced typewritten.
5. Technograph staff members are eligible for only one of the prizes.
6. Some articles will be printed in the TECHNOGRAPH.
7. None will be returned, but they will be kept on file and may be printed later.
8. Please include pictures, if possible, and permission for us to use them.
9. Any number of articles may be submitted by the same author.
10. The Technograph editorial staff will be judges for the non-staff articles.

Notes:

1. Ten typewritten pages with pictures makes three pages in the magazine.
2. Use rhetoric department punctuation and capitalization.
3. Many national companies will be glad to send you photographs and information.
4. Get started now and get several articles written and submitted by April 1, 1959.

$ $ $

STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

President, Douglas Aircraft Company

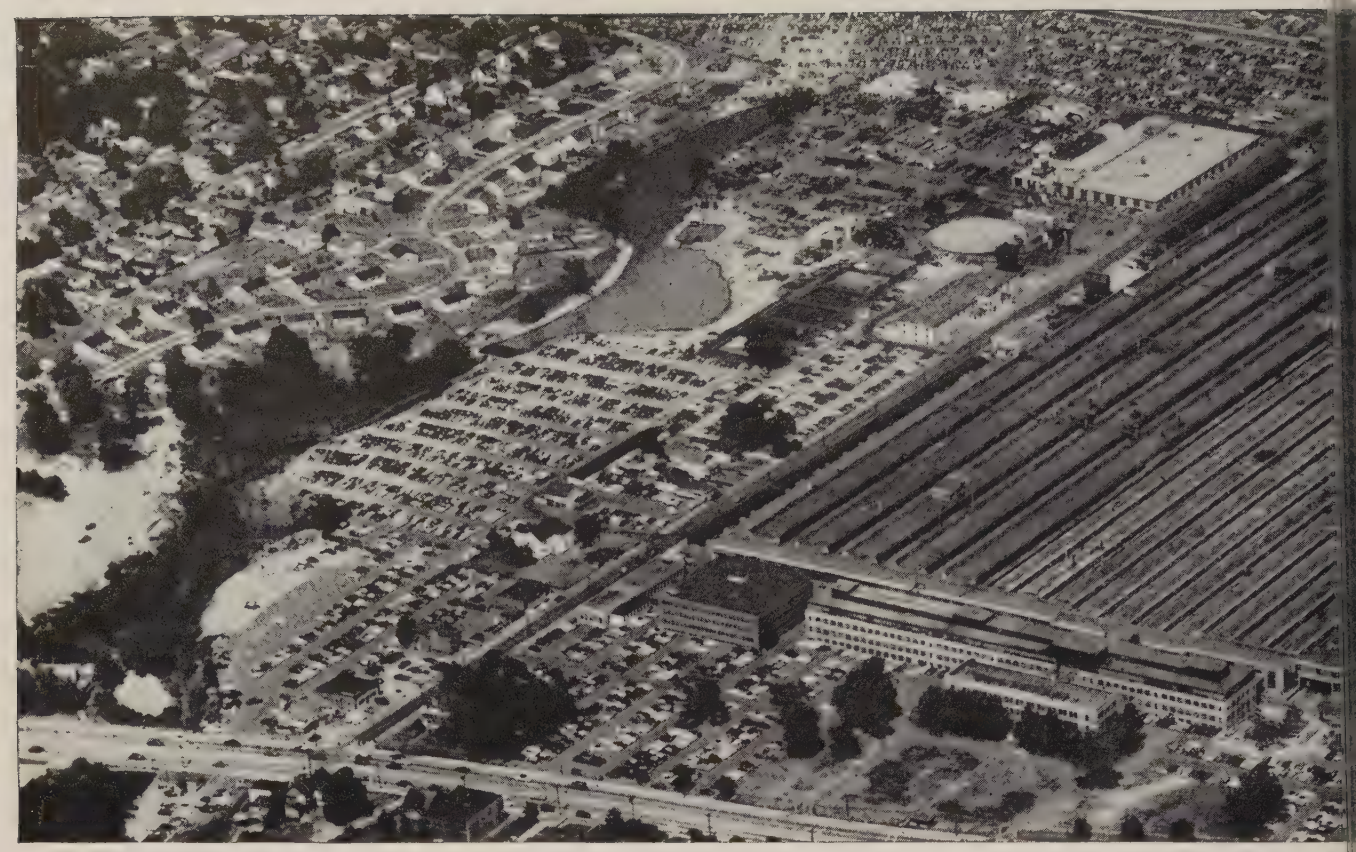
The "Space Age" isn't going to become a fact by itself. We engineers have to make it happen. Here's what Douglas is doing about it:

We've formed a top level engineering council to bring all our knowledge and experience to bear on the new problems relating to extreme high speeds and altitudes and to outer space.

This council is composed of the heads of our six major engineering divisions and is chairmanned by our senior engineering vice president. It will map out the most important goals in aviation and mobilize the scientific and engineering resources required to achieve them.

If you would like to become a part of our stimulating future, we'll welcome hearing from you.

Write to Mr. C. C. LaVene
Douglas Aircraft Company, Box 600-M
Santa Monica, California.



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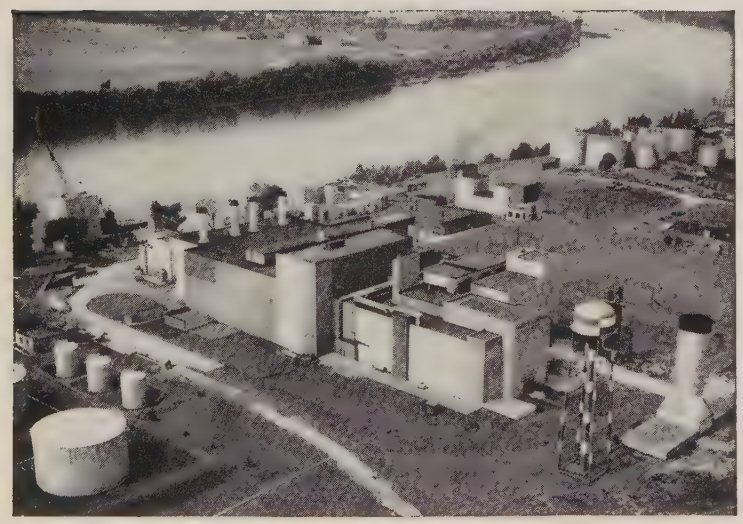
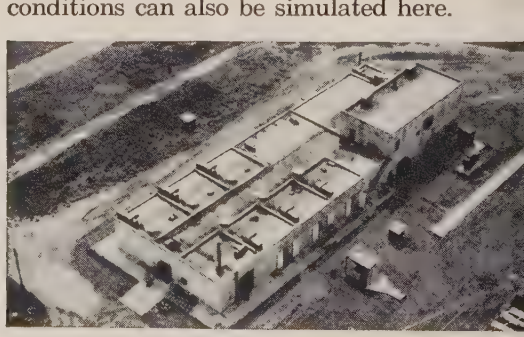
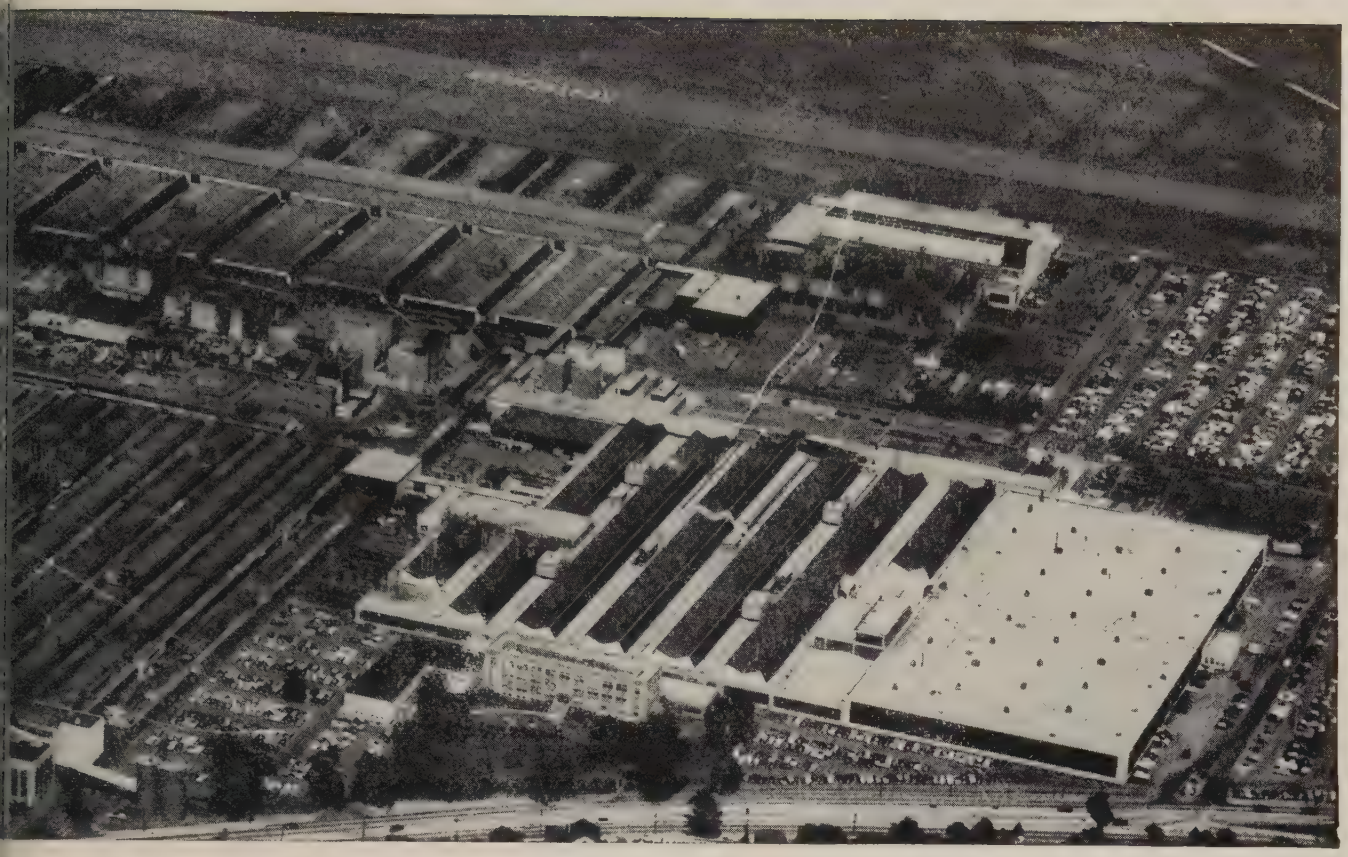


The Willgoos Turbine Engine Test Facility is the world's most extensive privately owned turbine development laboratory. Designed and built specifically to test full-scale experimental engines and components in environments simulating conditions at extreme altitudes and speeds, it is currently undergoing expansions that will greatly increase its capacity for development testing of the most advanced forms of air breathing systems.

In chambers like this at the Willgoos Turbin Engine Test Facility full-scale engines may b tested in environments which simulate cond tions from sea level to 100,000 feet. Mach conditions can also be simulated here.



In the new Fuel Systems Laboratory enginee can minutely analyze the effects of extreme en vironmental conditions on components of fue systems — conditions such as those encoun tered in advanced types of flight vehicle operating at high Mach numbers and high alt tudes. Fuel for these tests can be supplied a any temperature from −65°F to +500°F.



OPERATIONS

Unmatched Engineering Facilities for Developing Advanced Flight Propulsion Systems

Operations at Pratt & Whitney Aircraft are essentially those of an engineering and development organization. As such, an engineering atmosphere dominates the work being done, much of which directly involves laboratory experimentation.

In the past three decades, expansion at Pratt & Whitney Aircraft has been almost tenfold. In recent years, greatest emphasis has been on extending engineering facilities to meet the needs of advanced research and development programs in flight propulsion.

Among the Connecticut P & W A facilities are many that are unequaled in the industry. Thus today, Pratt & Whitney Aircraft is better prepared than ever to continue development of the world's best aircraft powerplants . . . to probe the propulsion future . . . to build and test greatly advanced propulsion systems for coming generations of flight vehicles — in whatever form they take.

The Connecticut Aircraft Nuclear Engine Laboratory, operated by Pratt & Whitney Aircraft, is situated on a 1,200-acre tract near Middletown. The Laboratory was specially built for the development of nuclear flight propulsion systems.

For further information regarding an engineering career at Pratt & Whitney Aircraft, consult your college placement officer or write to Mr. R. P. Azinger, Engineering Department, Pratt & Whitney Aircraft, East Hartford 8, Connecticut.

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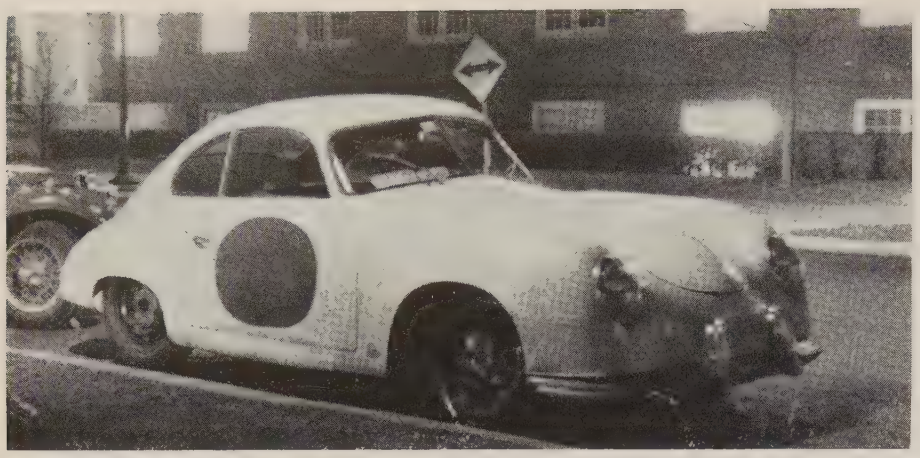
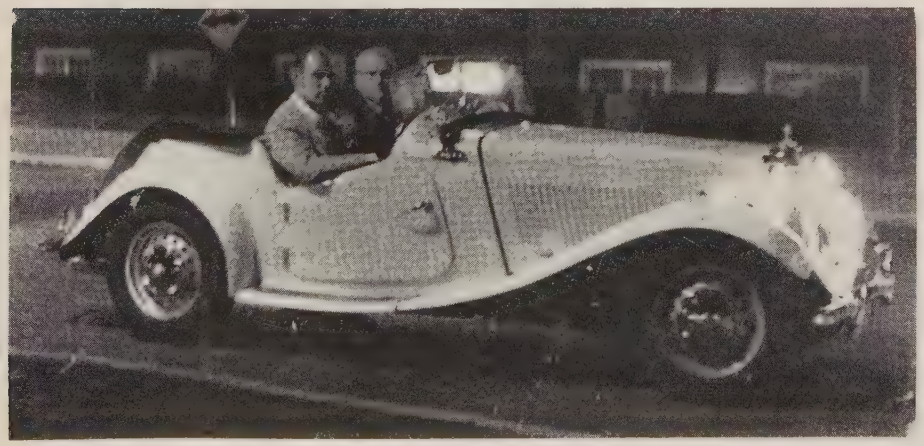


The Porsche design was efficiently tested in a wind tunnel giving it these trim lines. The engine mounted on the rear not only permits the clean overall design, but also provides a very roomy interior. The fuel tank and spare wheel are tucked away under the bonnet, therefore the luggage has to be stored behind the rear seat.

Not designed for all-out racing, the Mercedes-Benz 190 S-L is a top quality sports car capable of 110 mph and about 27 mpg. This car has over a one to one ratio of horsepower to cubic inches of displacement which is something seldom found in Detroit autos.



This older style MG exhibits the classic lines that were its trademark for so long. Although this design succumbed to modern trends it is still popular as a fine automobile.

(Continued from Page 14)

Sales boomed, so apparently he did. Market surveys showed a liking for chrome, power, size and accessories. But some people disagreed.

After World War II, some G.I.'s brought back the cars which they had met and grown to love in Europe. Compact, economical, and sporting performance based on light-weight and good design, they charged about, making monkeys out of the domestic products trying to follow them through the hills. Driving was fun again.

The philosophy of design in Europe had been considerable different from that in the United States and as a matter of course, had produced a different type of car. General income tended to be either lower than in this country, or considerably higher than the United States' average. Taxes on new car purchases and yearly licensing fees were inclined to be high, pushed there by governments badly in need of reconstruction funds. Roads were narrow and winding, with sharp curves and steep grades. Gasoline imported from the Middle East, became even more expensive, as taxes were loaded on the price to pay for road building. What could be the result?

Purchase tax and income level forced the price down. Gasoline prices necessitated economy. Yearly license taxes, based on engine displacement or size, made small engines popular. Road conditions demanded good handling qualities. European drivers, long accustomed to races, rallies, and hill-climbs, demanded a car that was interesting and enjoyable to drive. As this country produced cars featuring none of these virtues, United States' drivers were forced to turn to continental cars for economy, or driving pleasure.

And turn they did. From a long-time average of only a few thousand imports each year, the numbers began to creep upward. By 1953, about 10,000 were being brought in each year: a drop in the bucket, based on total sales in this country. But then, sales began to double, and each year they did so. By 1955, about 80,000 were sold. In 1956, the number was pushing 100,000. Still Detroit took no cognizance of the trend.

"IT'S" just a fad," chuckled the manufacturers. And in 1957, they were still chuckling as the sales went even higher. Then came 1958. Even as domestic automobile sales plummeted to a new low, the importers jauntily brought in 385,000 cars—and sold them. Rambler, made in this country, long decried as too small, cheerfully multiplied their share of the total market. The Studebaker Lark joined in, and

(Continued on Page 34)

WILLIAM F. BLOOMFIELD, B.S.I.E., LEHIGH, '53, SAYS:

"Join me for a day at work?"

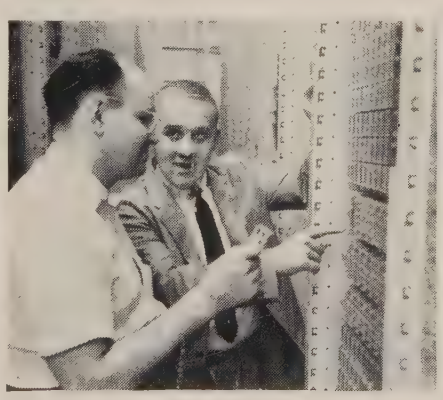
Bill is Plant Service Supervisor for New Jersey Bell Telephone Company at Dover. He joined the telephone company after graduation, has held many jobs to gain valuable experience. Now he has three foremen and 32 craft people working for him. "It's a challenging job and keeps me hopping," says Bill. "See for yourself."

"8:30 a.m. With my test bureau foreman, I plan work schedules for the coming week. Maintaining equitable schedules and being ready for emergencies is imperative for good morale and service."

"9:10 a.m. The State Police at Andover have reported trouble with a mobile radio telephone. I discuss it with the test deskman. Naturally, we send a repairman out pronto to take care of it."

"11:00 a.m. As soon as things are lined up at the office, I drive out to check on the mobile radio repair job. The repairman has found the trouble — and together we run a test on the equipment."

"1:30 p.m. After lunch, I look in on a PBX and room-phone installation at an out-of-town motel. The installation supervisor, foreman and I discuss plans for running cable in from the highway."



"2:45 p.m. Next, I drive over to the central office at Denville, which is cutting over 7000 local telephones to dial service tomorrow night. I go over final arrangements with the supervisor."

"4:00 p.m. When I get back to my office, I find there are several phone messages to answer. As soon as I get them out of the way, I'll check over tomorrow's work schedule — then call it a day."

"Well, that's my job. You can see there's nothing monotonous about it. I'm responsible for keeping 50,000 subscriber lines over a 260-square-mile area in A-1 operating order. It's a big responsibility—but I love it."

Bill Bloomfield is moving ahead, like many young engineers in supervisory positions in the Bell Telephone Companies. There may be opportunities for *you*, too. Talk with the Bell interviewer when he visits your campus and get the whole story.

BELL TELEPHONE COMPANIES

Lubrication of enclosed parts can now be inspected without disassembly. Standard Oil scientists have developed the instrument system shown here which measures the presence or absence of the required lubricant on concealed parts by checking the ability of the entire assembly to cut down radiation passed through it.

How to "see" without looking

At a final inspection station how would you make sure that enclosed parts were properly lubricated? Until recently, if you really wanted to know, you had to remove the housing, disassemble the mechanism—a costly, time-consuming process—and take a look.

But now Standard Oil research has solved the problem with a new instrument system that does away with disassembly. It passes radiation through the assembly and measures the amount that gets through. Inspectors can tell whether or not the proper level of lubricant is present without looking inside.

This remarkable device is just one of hundreds of ways in which Standard has helped industry solve problems connected with lubrication. It was developed by a team of Standard Oil scientists and engineers who saw the need for a new approach to an old problem.

Such creative thinking is the product of the atmosphere in which Standard Oil scientists work. They have the time, the equipment and the opportunity to contribute to the progress of their industry and their country. That is why so many young scientists have chosen to build satisfying careers with Standard Oil.

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THROUGH RESEARCH

When engineers were first laying out the vast installations at Los Alamos, an inspector was sent to New Mexico to check the progress. The first day there he saw a remarkably pretty Indian girl walk past, and he noticed that several of the engineers looked up appreciatively too.

About a year later, the same inspector went out to Los Alamos again for a progress check, and again he saw the same red-skinned beauty. This time, however, she had a papoose strapped to her back. Tipping his hat, the inspector smiled at the girl. "Hello there," he said. "I see you have a papoose. Him little Injun, eh?" The mother looked at him impassively. "Him only half Injun—other half Injuneer," she said.

* * *

Of course you've all read the immortal words of Benjamin Franklin: "Kid, keep your damn hands off my kite!"

* * *

A visiting psychiatrist, wandering through a mental institution on a tour, saw a man huddled in the corner.

"My good man," he asked, "why do you sit in the corner all huddled up and scratch yourself?"

The man answered, "Because I'm the only one who knows where I itch."

* * *

Opera is where a man is stabbed in the back and instead of bleeding he sings.

* * *

He would make an excellent ROTC student—strong, courageous, ready to step into any peril, never questions orders, he just carries them out. You know, a moron.

* * *

There was a Scotsman who wouldn't buy his girl a parasol when they went to the beach, but told her shady stories instead.

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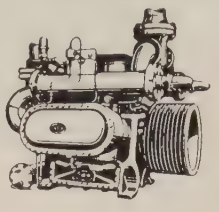

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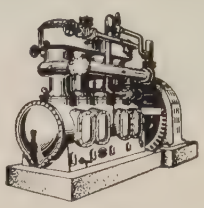

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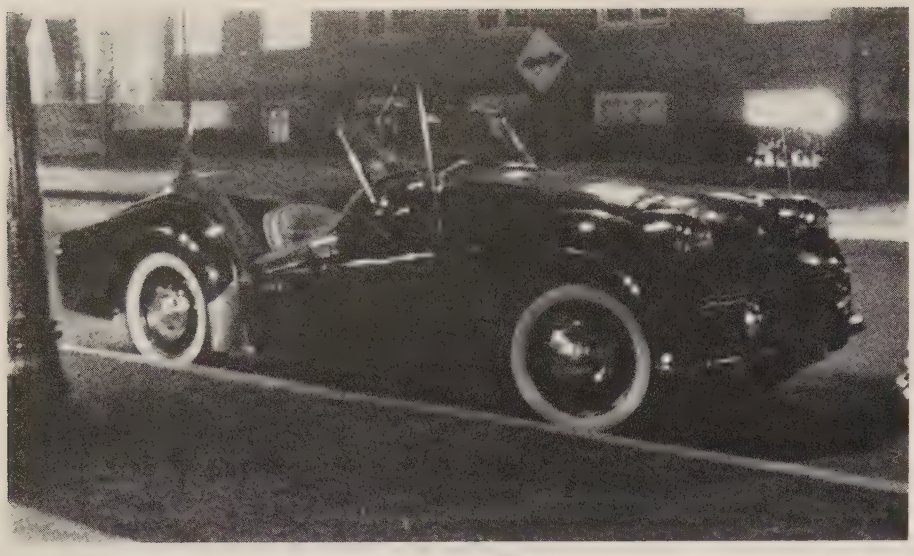
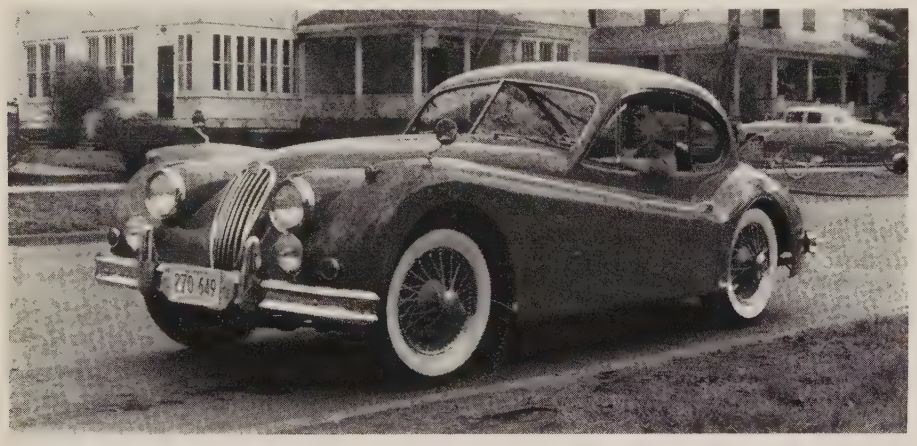
Help Wanted!

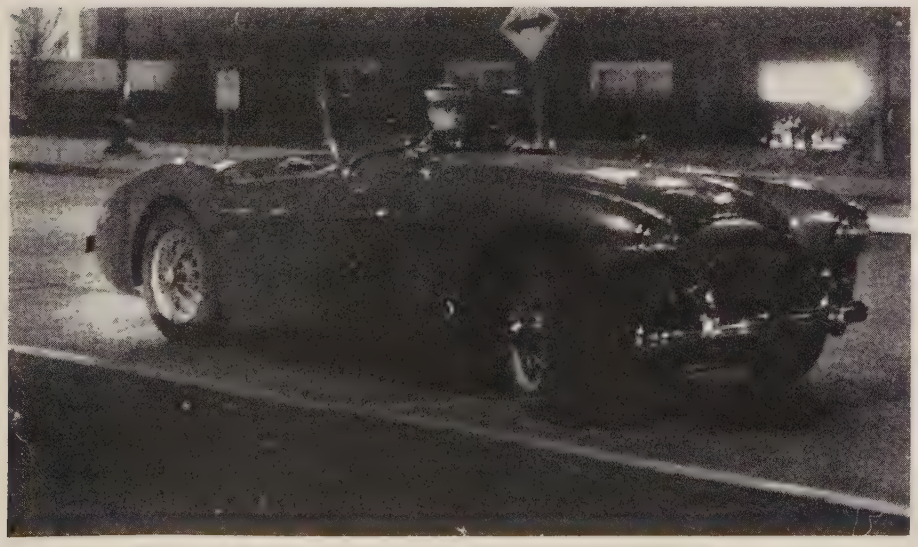
Positions are available on the editorial and production staff of The Illinois Technograph. Experience of this type is invaluable for personal satisfaction, job references, and development of creative skills. Applicants need not be engineering students. Interested persons may call the editor, Dave Penniman, at 2-4254 or leave their name at The Technograph office in 215 Civil Engineering Hall.



Although small even by sports car standards, the Triumph provides seating in the rear for two children or one adult. Considered quite a value at a price of just over $2500 the Triumph offers good gas mileage and a top speed of over 100 mph.



Along with the M.G. the Jaguar is given credit for creating and developing the American interest in sports cars. The Jaguar still remains one of the best buys on the basis of performance per dollar.



The Austin Healey's roadability is second to none, its acceleration remarkable, and its comfort excellent. A roomy two seater this car presents a combination of qualities which makes it well worth the price.

(Continued from Page 30)

chopped another chunk out of the big-car market. The compact car had grabbed 15% of the market, only recently claimed an impossible amount, but why? Who really kicked the desk chair out from under the usually-smart auto industry and left them in such an awkward position?

As it was the consumer who did not buy, then the answer must be that he was not pleased with the offerings from Detroit. The answer lay in market research; the key being that the automobile had slipped as a social symbol into a new position. That this was not discovered sooner was due in part to the fact that many, many Americans say one thing—but believe or do another.

After years of trying to park 20 foot cars in 18 foot garages, of back-and pulling out of parking spaces, the buyer began to wish for a more compact car. While pouring his pocketbook into the gas tank, he dreamed of better economy. Faced with high prices, he began to look for lower costs. Staring at fabulous depreciation, literally draining his investment, he questioned the wisdom of buying a new car every year. As the more individual consumers, and often the more influential, changed their habits of automobile buying, so did many other people. The new car, once the goal of every young married couple, now was recognized as somewhat impractical. And so the stature of the sports car grew, and with it, then surpassing it, the compact sedan.

To gain this degree of acceptance was not a cut and dried process for the automobile importers. Several important obstacles had to be overcome, chiefly service, safety, and styling. On the positive side of the ledger already lay depreciation, reliability, economy, and handling. Due to the relative infrequency of model changes, European manufacturers relied instead on gradual evolution and design improvement, rather than the re-hanging of fins and chrome. Traditional craftsmanship and demand for low maintainence kept the cars running for long periods without repair. High fuel costs had forced good gas economy, and driving conditions required ease and precision of handling. Banking then, on these factors, steps were taken to overcome sales resistance.

Styling posed little problem, as exposure to the European design concept created acceptance. As a further aid, some modifications were made to closer suit American tastes.

Complaints about safety took but little more attention, even though still often heard, for it was never really a problem in the first place. The Corvell-Liberty auto safety studies showed no

(Continued on Page 41)

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Shortly after World War II, there began extensive development of high altitude rockets by the major powers of the world. As a result of this, practical use has been made for a number of years in the area of ground-to-air rockets which have completely replaced the familiar anti-aircraft gun. Current examples of these are the Nike and Ajax rockets.

In order to best understand the rockets of today, an examination of the two basic types of propulsion units should be made. These two types consist essentially of the solid-propellant type and the luquid-propellant type. Applications of the solid-propellant type rocket have been extensive but the main problem is the instability and changeability of the propellant over a short period of time. Common types of solid propellants usually fall into one of two categories: nitro-cellulose or nitro-glycerin.

The second type of rocket (and currently the most widely used) is the liquid-type unit which in its simplest form uses a mixture of liquid oxygen and alcohol. In figure 1 is a typical fin-stabilized, liquid-propellant type rocket. The main components of this unit consist of a fuel tank of alcohol, a separate oxidizer tank, individual pumps, a combustion chamber for uniting and ignition of the chemicals, and the payload and/or guidance system. Here lies the important aspect of the rocket engine that will enable man to realize his dreams of space travel. The rocket engine possesses an inherent ability to provide thrust without an outside source of air as opposed to the jet-type engine.

It is now that we arrive at the second important area of rocket development—which concerns the present. Since the nineteenth century, noted authors such as H. G. Wells in his "First Men To the Moon" have depicted in detail the conquering of space by man. Significant in the field of technical fiction was the dramatic radio program by Orson Welles, in 1937, when he alarmed the nation with his vivid and realistic story of the invasion of the earth by the Martians.

Once again, an important contribution to man's accelerated progress is public acceptance. Without a doubt, much of the science-fiction available to us today is trash, yet some of it is accurate and stimulating. As the years go by, historians will no doubt point out the important contribution of these novelists, for it was, is, and will continue to be the one means in which public acceptance will be kept up with the accelerated technical developments. Past history has pointed out that one of the big problems of any new invention has always been the skepticism of the public.

The present era could perhaps be best described as that of the Sputnik era. With the placing of Russia's Sputnik sattelite into orbit on October 4, 1957, man has inaugurated and stepped into a new dimension. Perhaps no other single achievement has influenced so rapidly man's technical, political, military, economic and educational thinking as have the current satellites of Russia and the United States.

The third area of rocket development lies in the category of the future. Many articles have been written as to what the future might bring. The distant future still, of course, remains in the field of science-fiction; however, shorter range predictions have been made which allow man to reliably inspect the near future.

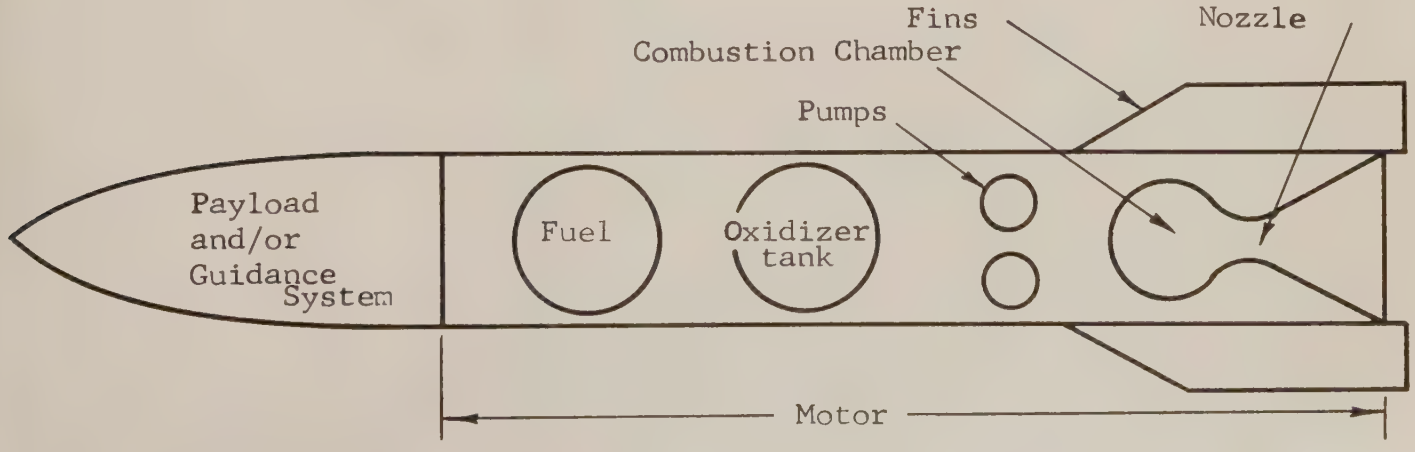
Leading scientists, such as the noted Wernher Von Braun, illuminate the future with an authoritative space time table such as illustrated by this chart. Examination of this space time table illustrates nine basic and fundamental steps for man to achievements before he can actually "travel" to stars. The first and second of these achievements have essentially come to pass with the several orbiting satellites that have been launched. The third in this series of steps will be manned missiles that will operate in the threshold area of forty to one-hundred miles from the earth to determine man's tolerance to space flight. The fourth step will include larger satellites operating at greater distances and will probably be launched in 1960 or shortly thereafter. Steps five and six will include the unmanned vehicles to the moon which could be achieved virtually any day. The first flights will be circumnavigational, being directed into an eliptical orbit around the moon and back. A seventh and perhaps most important step will include a piloted satellite or space platform giving man his "stepping stone" to the stars. The eighth step might realistically see a manned trip around the moon itself launched either from a space platform or the earth's surface, depending upon technological developments. The crowning achievement in this series will, of course, be that of man landing on the moon itself.

These then are the predictions for the near future and are, by logic, in regard only to our neighboring natural satellite, the moon. As far as the rest of the solar system is concerned, there is no reliable basis for prediction.

Although no predictions can be made for the distant future, the scientists of today can give us a glimpse of the means with which man might traverse the heavens. For this glimpse, an astronautic systems chart has been prepared by The Convair Division of General Dynamics. This chart depicts the various types of

(Continued on Page 36)

FIN STABILIZED LIQUID PROPELLANT TYPE ROCKET



(Continued from Page 35)

drives that may come to be used. The vertical scales dimensionally show the distances to various targets, expressed logarithmically in nautical miles. Superimposed on the vertical scale is the range of application of the various propulsion drives. The horizontal scale increments the velocities required for flight distances in thousands of feet per second. Important then, and extremely interesting, are the possible types of propulsion drives which include (1) chemical, (2) atomic pile and arc heating, (3) electrical or ionic, (4) nuclear or fusion, and (5) photonic drive. Among the most interesting of these drives is the photonic drive, which provides thrust by means of pressure of emitted light. Present day theory tells us that a vehicle with the speed of light could never be achieved, but only approached. It is here where this photonic drive would become the most likely to provide these speeds. However it is extremely interesting to note that such a drive would provide a relatively slow acceleration rate and any such attempt would take many generations of manned operators before the vehicle could attain a velocity of a significant fraction of the speed of light. Herein then, lies the awesome problem — whether ionic, fusion, or photonic drives are chosen as a means to traverse the greater depths of the universe, the inhabitants must be prepared to propagate themselves through time and space on their way to the stars.

In the realm of more immediate problems regarding space travel, is the field of space medicine. Some of the more prominent problems include the acceleration effects on man, absence of gravity, and cosmic radiation. Important contributions in this field have been made by such noted men as Col. Stapp and Major Dr. Simons, both of the United States Air Force, who have been, and are presently, investigating some of these effects on man in high altitude balloons and on rocket sled tests. Important also are the countless other psychological and physiological problems such as confinement in small quarters for long periods of time.

In summation, then, the important effects of rocketry in this Sputnik era have been to produce a virtual reformation on the technical, political, military, economic, and educational thinking of man as no other inventor has. Because of a lack of time and in order to more fully comprehend this intriguing and vast subject of rockets and space travel, the pamphlet entitled "An Introduction to Space Travel" is provided for more extensive reading.

What is in store for us? It still remains to be seen. At any rate, there'll be more for young lovers to watch in the future than the man in the moon!

FALLOUT

by Jerry Hill

Everybody these days is thinking about it, almost everybody is talking about it, and, strange as it may seem, somebody actually tried to do something about it, which is rare in a culture such as ours.

The public has become fallout-concious.

They were testing the bombs all along, and naturally, there was fallout, but nobody knew about it and nobody paid attention.

Fallout was negligible.

Anyway, they thought fallout was negligible, because they didn't actually know anything about it, not enough to interest them in it.

They didn't know anything about fallout; somebody had to tell them, had to make them fallout-conscious.

One day, somebody created a controversy.

Controversies are wonderful things, for the person who creates them that is; you see, he makes money.

Somewhere, in someplace that was noplace because the public didn't know about it, was a person who knew.

He knew about nuclear fission.

He knew about nuclear fusion.

He knew about the meson.

He knew about the quantum, he knew about the Planck axis, and he knew about the physical functioning of the interlaced intricacies of the entire cosmos.

He knew about fallout . . .

And because he knew about fallout, he wrote books and he wrote articles . . . about fallout.

The public ate up his books and articles, they had found something new and interesting, they could read about fallout.

But even after reading this person's books, the public had not become fallout-conscious.

Somebody made a mistake. This somebody who didn't know about fallout realized that this person who knew was making money writing about fallout.

This somebody decided he'd climb aboard the bandwagon that this person who knew had created.

And others followed . . . and they didn't know either.

They wrote books:

"Anatomy of a Fallout."

"My Fallout is Quick."

"God's Little Fallout."

They produced movies:

"The Best Fallout of our Lives."

"King Solomon's Fallout."

"How Green was my Fallout."

There were TV shows:

"I've got a Fallout."

"What's my Fallout?"

"Tic Tac Fallout."

But they didn't know and this person who did sat way off in someplace that was noplace because the public did not know about it and just chuckled to himself.

The public became fallout-conscious and this was their mistake.

The public was not only fallout-conscious, the public was frightened.

And when they became frightened, they discussed it with their neighbor.

They talked about:

Sterility and mutation, particles and isotopes, chromosomes and reproductive cells.

The public was fallout-conscious and they yelled: Stop testing!

And the nations met and talked about stopping the testing . . . but still they tested. And the public yelled: Stop testing!

Somebody gave a speech:

"If we don't stop testing we're going to contaminate the air and make this place unlivable and it'll be horrible and our children are going to have two heads."

And they looked up into the sky and everytime they saw a dark cloud, they pointed at the fallout that was going to destroy them.

So they formed committees and they thought about it.

Everybody these days is thinking about it, almost everybody is talking about it, and, strange as it seems, somebody actually tried to do something about it.

They say that the rain is loaded with it and that everytime it rains, it rains fallout. . . .

I don't worry about it. . . .

You see. . . . I've got a lead umbrella. . . .

CATHODIC PROTECTION

(Continued from Page 17)

electrical motors. Correlations are made between speed of rotation, rate of corrosion, and CP requirements. Top speeds of 10,500 rpm have been reached, and results have indicated a straight-line relationship between speed and rate of corrosion. This means that the amount of cathodic protection required for complete corrosion prevention is proportional to speed. In addition to the corrosion problem, the CPL is concerned with the phenomenon of cavitation—a rapid loss of metal at the propeller tips.

Cavitation is of special interest because the metal loss is caused by a non-corrosive action. As the propeller revolves, cyclic increases and decreases in pressure occur, and gases that are present in the water bubble out of solution during low pressure and go back into solution during high pressure. In going back into solution, the gases produce stresses up to 100,000 psi at the propeller tips, and these stresses effectively "pull" metal away from the surface.

The hypothesized solution to cavitation is that hydrogen generated by the CP system (the propeller acts as a cathode) will nucleate the gas bubbles at a safe distance from the propeller surface.

Cavitation speed has not yet been reached; consequently, there has been no evidence that the theoretical solution will be practical. Results of cavitation research are awaited with great interest, for if the CPL is successful in preventing cavitation with cathodic protection, an entirely new concept in CP applications will have been found. The Navy will, of course, be rid of a very troublesome and costly problem.

The Future of Cathodic Protection

With annual corrosion losses reaching a total equalling nearly 15 per cent of our national budget and with the rapid expansion now taking place in the pipeline industry, we can safely anticipate an accelerated research program in cathodic protection. And the current exploration of cavitation indicates that we may see more research in applications of cathodic protection to problems other than corrosion. With such motivating factors, the young engineer might do well to consider a career in this challenging field.

A hen, hit by an army jeep, got up, straightened out her feathers and said, "Lively little cuss . . . but he didn't get anywhere."

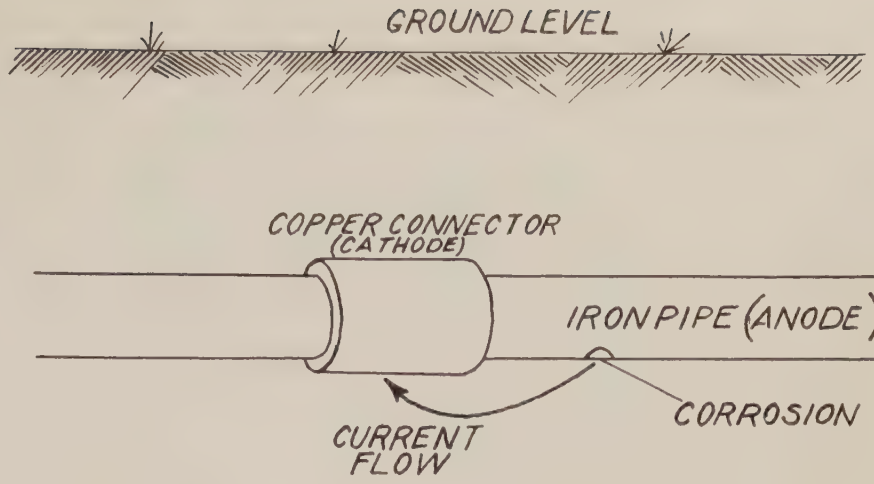


Fig. 4. Illustration of electrode formation caused by using a copper connector on an iron pipe. With respect to copper, iron is more electropositive; therefore, it acts as an anode.

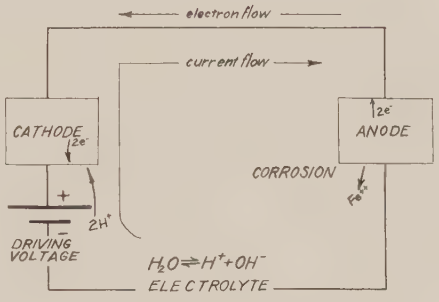


Fig. 5. An iron corrosion cell

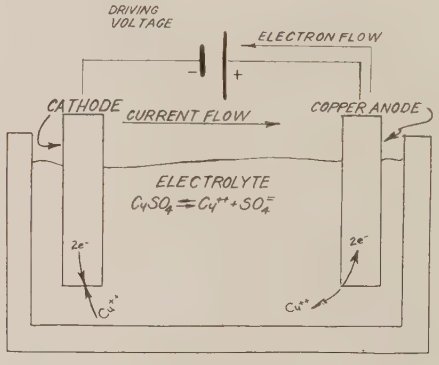


Fig. 6. A copper plating system

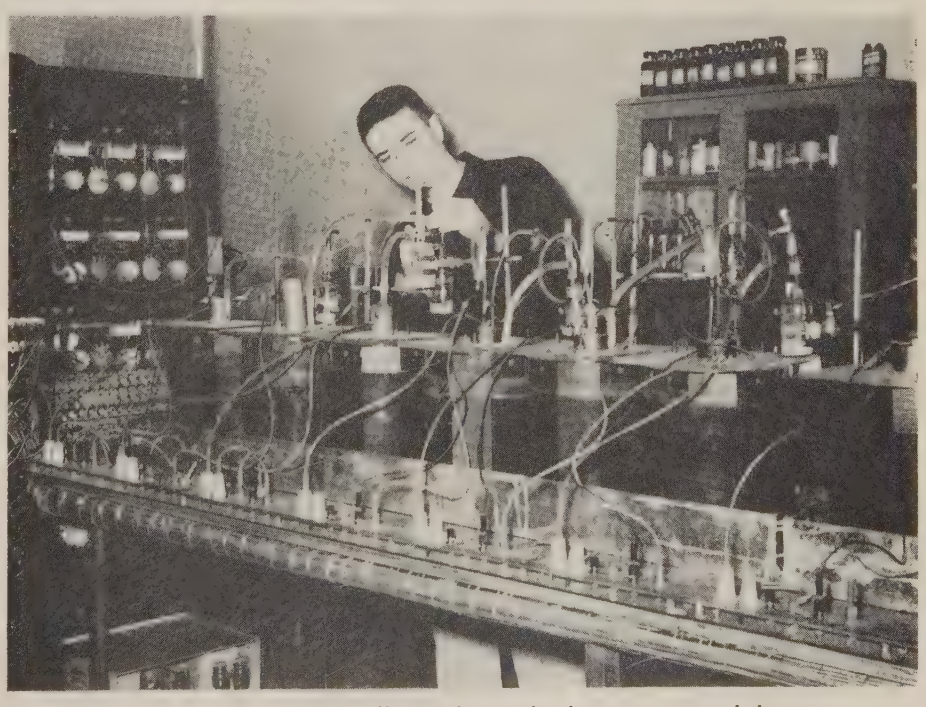


Fig. 7. Electrolytic test cells in the cathodic protection laboratory

Technocutie . . .

(Photos by Gerald Lewy)

SUSAN WATTS

Evanston's loss was our gain when Susan Watts enrolled here last fall. She is in LAS and plans to major in English.

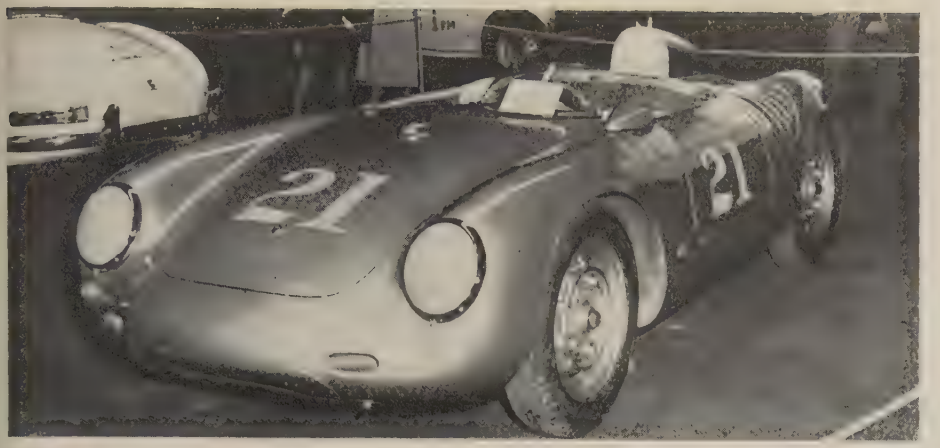
During the summer she likes to water ski, swim, and play tennis. She is also musically inclined as she plays the piano and sings.

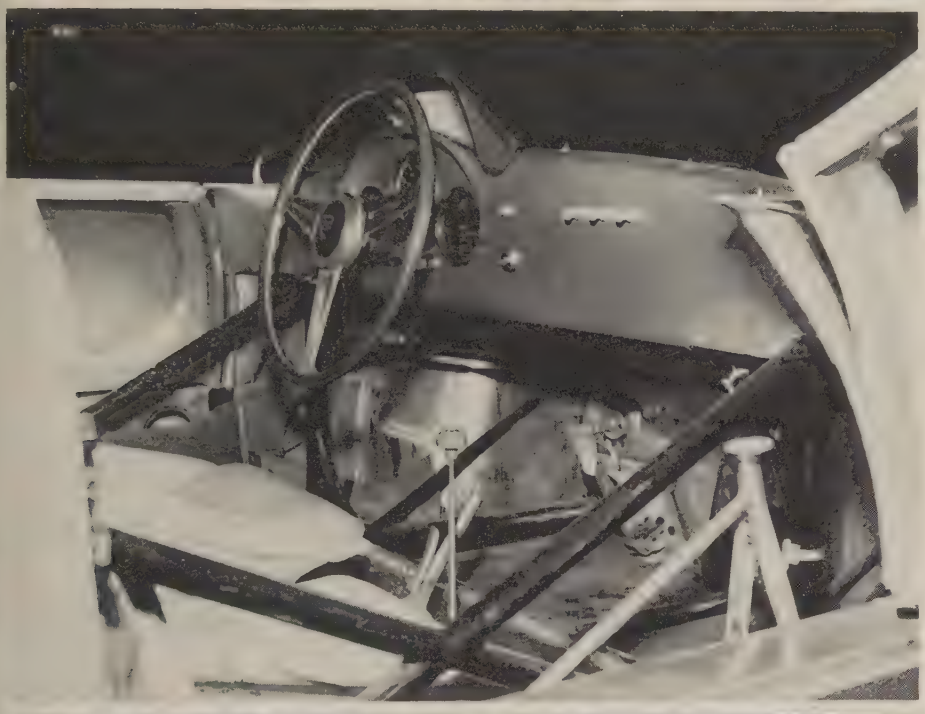
Things she likes include: Pogo, jazz—Brubeck style, hot fudge sundaes (more than beer), and pink and red.

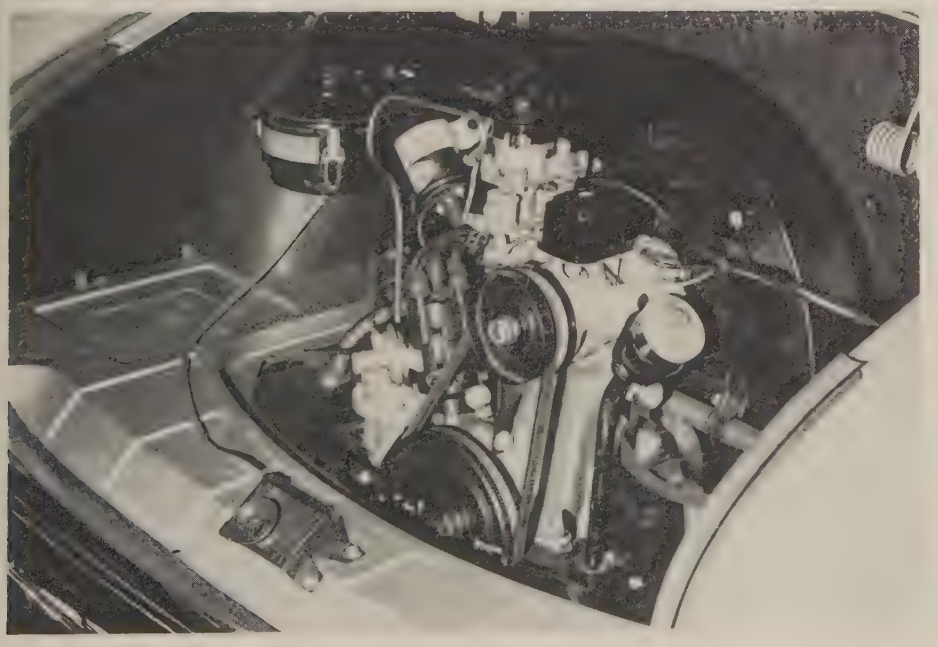
Susan says that she likes boys with initiative and sincerity, but no line.

She is 5' 7" tall and weighs 122 pounds. Her measurements are 35"-22"-35" and very nicely placed we would say.

Her home on campus is Kappa Kappa Gamma, and the phone number is in the book. Let's see if you have any initiative future engineers.







It is in cars such as this Porsche Spyder shown in these three pictures that much experimental design work may be done. Tests under racing conditions give performance data not apt to be misleading. Notice the lack of luxury in this strictly functional cockpit, and also the rear mounted engine which adds greatly to cornering ability.

(Continued from Page 34)

measurable difference in safety between large and small cars. Common sense dictated that a responsive vehicle should be able to stay out of trouble more easily, as in fact they seem to. Most owners, displaying a fondness for safebelts, remained with their cars in infrequent accidents and were not hurt. The cars themselves, when they did get into accidents, stayed in one piece and did not collapse, further safeguarding the passengers. With these facts known, objections to safety began to melt away.

The complaints on service took a more expensive cure. Solving this problem took extensive dealer networks, huge parts stocks, and trained mechanics. Dealers were franchised until some imports found themselves with more outlets than certain native-born cars. Warehouses all over the country were established and stocked, featuring overnight parts service to any part of the country for virtually every make of car. As a condition of their franchise, dealers sent mechanics to special schools so that they could become service experts.

Publicizing these advances, dealers found themselves growing, selling all the cars they could get, and often establishing waiting lists. More dealers entered the field, more customers turned to their products, and even today the snowball keeps growing.

No alert manufacturer ever overlooks an untapped or expanding market, and make no mistake, Detroit is alert. They, too, will enter the field, though hampered by two characteristics. Watching their sales remain high until 1958, the industry could see little reason for change. After all, if people buy the cars, they must like them. Anyway, various groups had been making noises about more compact, sensible cars for some time, and they had gone ahead buying chrome-festooned, 20-footers. Where tooling costs money, mistakes can mean financial disaster, as witness the monumental collapse of the Edsel. Hence, of necessity, the manufacturers maintained a cautious outlook toward such a radical design concept. Even so, once a decision is made, the unchangeable enemy, *time,* enters the picture. Extensive work is needed prior to a new model for design, styling, tooling, and production set-up. The industry standard is three years. That Chrysler brought out the 1957 models in two and one-half years is remarkable; that the compact cars are to appear in two is amazing. It is also indicative of the importance placed on filling this vital gap in the industry's offerings.

Speculation concerning these offerings continues rampant, but several

(Continued on Page 44)

This Can Be You....

Carroll W. Boyce, B.S. in Business and Engineering Administration, M.I.T., today is a key managing Editor of FACTORY Magazine

Assistant Editor; Associate Editor for editorial plans; Special Projects Editor. These steps up the ladder have brought Carroll to his present position of executive responsibility on McGraw-Hill's FACTORY MANAGEMENT AND MAINTENANCE.

Carroll Boyce is the author of numerous articles; guest lecturer at Graduate Schools of Engineering and professional societies, Consultant to the Administrator, National Production Authority; member, American Society of Mechanical Engineers, the National Press Club and other leading organizations.

"During my four years at M.I.T.," relates Carroll, "I was an editor of the Tech Engineering News. I discovered that I enjoyed both writing and engineering, so I decided to combine the two. Knowing that McGraw-Hill is the largest publisher of business magazines, I wrote a letter to the Personnel Department. In a way, it was probably the most important letter of my life. I was hired!

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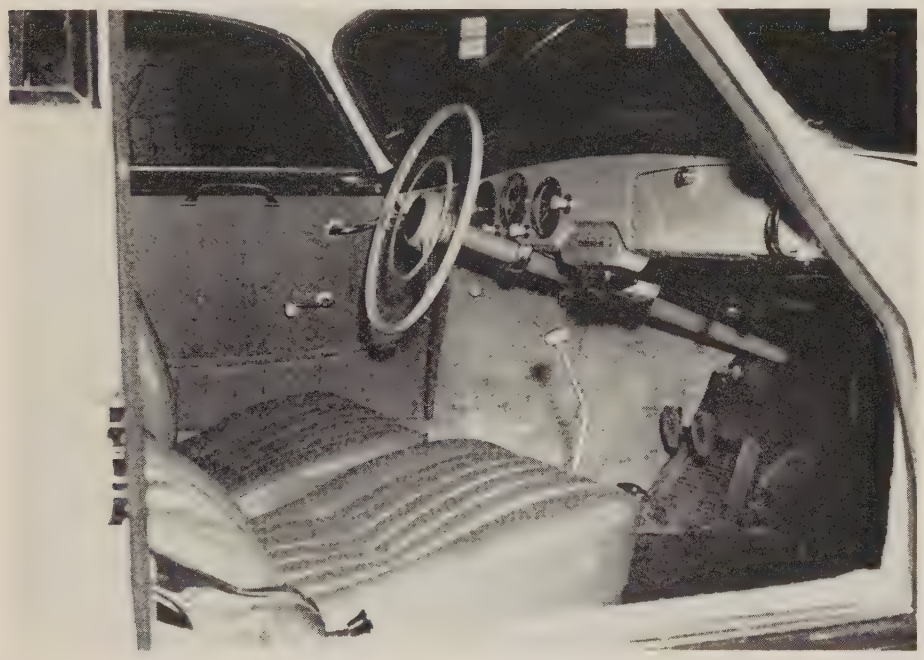
'op Engineer-Journalist

What's in a brain? Carroll (standing) gets an advanced briefing on the latest developments in the Univac Electronic Computer from Charles Katz of Remington Rand.

The Renault Dauphine is one of the few economy cars that can boast of first class wins in the Mille Miglia. It is performance such as this that makes import cars so popular even in a country with the large automobile industry we have.



This interior belongs to a Porsche coupe and disproves the mistaken idea that foreign cars are cramped and offer little leg room. American cars would do well to combine performance with comfort and come up with the same quality offered in this car.

The aerodynamically styled MG-A is a bold departure from previous MG's; they're credited with creating the present-day U. S. sports car market. This new model is faster and more comfortable.

(Continued from Page 41)

ideas seem close to the truth. General Motors will probably be the first to hit the market, with their offering as a rear-engined model, probably with a choice of sedan or station wagon. Featuring a flat, aluminum, air-cooled, six cylinder, optional automatic transmission, it promises to have wide appeal as a well-engineered automobile. Styling at this point is evidently similar to the French Renault Dauphine, but on a 106 inch wheelbase.

Evidently, too, a slightly larger car based on the same "shell" will be marketed by Buick, Pontiac, or Oldsmobile Dealers. The name has been the target of every rumor-mill in the country with Chevrolet engineers calling the project Corvair, and other G. M. people using X-Project, Holden (the name of G. M.'s Australian small car), Kaydet, and Chevrolittle.

Whatever the Ford version of this theme is called, it seems set for a showing somewhat later than the G. M. project. Leaks to date identify it as having a conventional, small six-cylinder engine in front, wheelbase in the 100-110 inch range, and looks similar to those of the British Ford products.

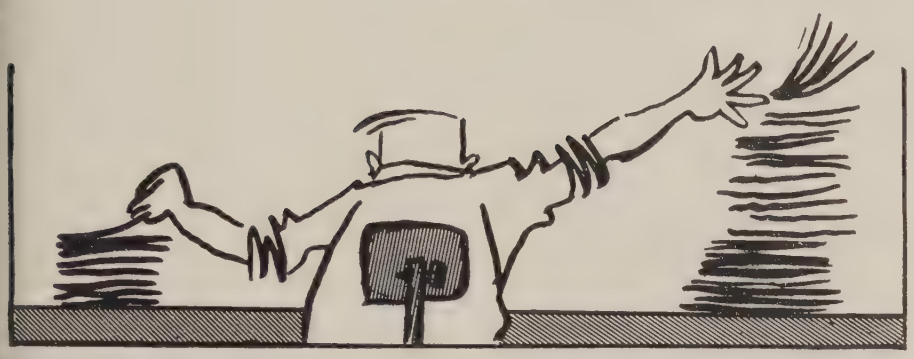
Chrysler is once again the bridesmaid, as their entry is not expected until early 1960, which will hurt initial sales. Supposed mechanically to resemble the Ford offering, it's styling is reportedly Italian in taste, and somewhat flashier than the entrants from the remainder of the Big Three. The name choice centers on Falcon, with equal members of reliable sources affirming or denying this label.

The present lines, at least, will be continued, though here, too, a change seems in the breeze. Sparked by the success of the Thunderbird, other entries are foreseen in the medium-priced, medium-sized field. The Edsel, hardest hit in 1958 by the swinging pendulum of auto sales, seems destined to a 1960 or 1961 change to the 112-115 inch wheelbase field.

Also, in previous years, all changes have been with one idea in mind: That the new product should bear a resemblance to the old, be recognizable for the make it is. Only disaster has changed this. Chrysler forgot the principle for its new line in 1955 and prospered, while the G. M. line broke completely in 1959 for its new models. Rapid design flux seems to be the destiny of the new small cars, ever more than in the parent times, for they have no backgrounds to be coddled.

Now that we have traced the history of the automobile through the present, we shall, in a later issue, examine in detail the effect of sportscars on American life.

Skimming Industrial Headlines



Edited by The Staff

Law Enforcement Photography

How color photography aids law enforcement officers in examination of questioned documents was recently revealed by Harris B. Tuttle, Eastman Kodak Company's consultant on law enforcement photography.

Speaking before the questioned documents section of the American Academy of Forensic Sciences meeting in Chicago, Tuttle told of methods for determining whether a ballpoint pen message was written under or on top of a typewritten message.

He stressed the importance of color photography in presenting evidence in such cases.

When a ballpoint message is written over a typewritten one, the pressure required to put ink on the paper leaves a groove over the type characters that is visible under specialized viewing conditions. By using oblique lighting and low magnification, the pressure groove can be photographed in color to provide evidence.

Earlier methods of determining a superimposed ballpoint pen message involved study of deposition of ink. Where ink from the typewriter ribbon appears, there are no paper fibers available to absorb the ballpoint ink and none appears over the typewritten characters. However, this test would not work where a weak typewritten key or a worn ribbon leaves unused paper fibers to absorb ink.

The reverse condition, when a message has been typed over ballpoint pen writing, is also detectable through the groove left by a pen. When the typewriter key strikes the page, this groove is flattened out, and the type character leaves an inked impression in the paper that is easily visible under low-angle lighting.

Tuttle also discussed other problems in the photography of such documentary evidence, such as the length of time the groove will remain in the paper, depth of field and magnification for color photography and materials for making the pictures for use in court.

UHF Air to Ground

Development of the first commercial high speed air-to-ground telementry system for operation in the newly assigned 1345-1465mc microwave telemetry band was announced today by Philco Corporation and Consolidated Electrodynamics Corporation.

First use of the equipment will be on the DC-8 flight test program. An initial system has been delivered and is presently undergoing preliminary flight tests.

With this new system, vast amounts of vital flight test data, such as engine performance, airframe stress, etc., is instantly relayed to the ground where it can be evaluated more effectively and economically.

Manufacturing and marketing of the new air-to-ground telemetry equipment is being handled by Philco's Government and Industrial Division.

Built to meet environmental requirements, the compact, airborne transmitter has sufficient power output to operate at a range of 100 miles from an altitude of 5,000 feet. Greater ranges are expected from the normal operating altitude of jet aircraft. The transmitter uses frequency multiplier circuits and tuned coaxial cavities to produce output power in excess of 20 watts at any frequency within the band.

The FM superheterodyne receiver has an oscillator stability of $\pm.002$ per cent with an overall noise figure of 8 db. The use of an auxiliary converter permits operation from either 115 volt 60 cycle or 115 volt 3 phase 400 cycle power.

The receiver has been installed in a mobile ground control record station housed in an air-conditioned trailer. A remotely controlled tracking antenna, similar to those used for radar equipment, is mounted on another trailer.

Gold Recipe: Take One Pig—

According to Malay natives, gold can be created from brass. Here is the recipe: Slaughter a wild pig, remove its entrails and stuff carcass with brass. Then sew back together, cover with wood and burn down to embers. Wait until wood is hidden with freshly grown grass, then start digging, and the brass will have turned into a pile of pure gold.

Stable Yellow Pigment

Nickel, which is used in making over 3,000 alloys, is now serving industry in yet another role. This versatile metal, it has recently been found, contributes color stability to yellow paint pigments.

The problem of developing a yellow paint that would retain its yellowness through years of outdoor exposure had long perplexed the paint industry. Of all paints, yellow was especially susceptible to the ravages of sunlight, heat, moisture and corrosive atmospheres.

But now there's no longer need to "wonder where the yellow went." Two new nickel-containing pigments, Sun Yellow N and Sun Yellow C, have been developed to make yellow paints that retain their color even in temperatures of over 1,000-degrees F. Combining outstanding light fastness with alkali and heat-resistance, they are also impervious to acids. The Sun Yellows are used in outdoor and masonry paints, as well as in automotive and industrial finishes where a permanent yellow color is desired.

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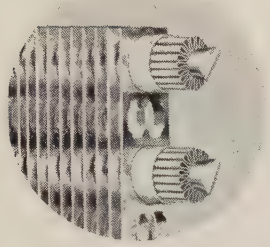

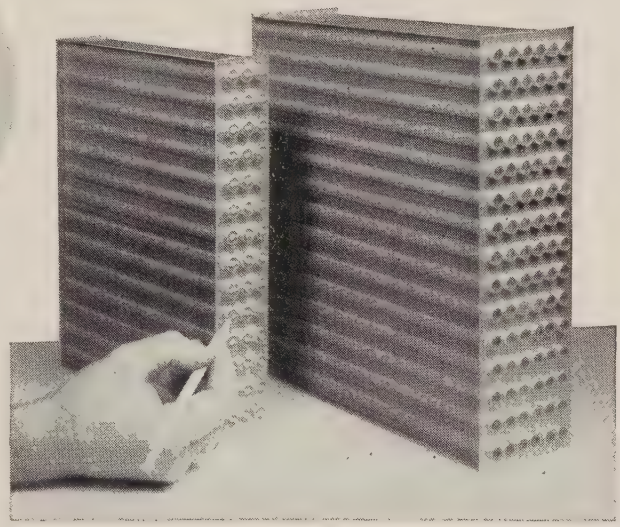

*Inner-fin tube has an "R" factor (internal coefficient) of 5.05. This spirally wound surface is an excellent turbulence promoter. It positively prevents channeling and has the highest value of overall heat transfer coefficient of all types of heat transfer coils.

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titanium dioxide were found to produ color-tinted varieties of this popular pi ment. The specific combination of nick oxide and titanium dioxide yields a ligh yellow pigment. Besides imparting th yellow color, nickel, which is present the extent of about three per cent, co tributes to the pigment's high durabilit and chemical resistant qualities.

Antioxidants For Plastic

A number of new additive combina tions which are exceptionally effective i inhibiting the oxidation of polyethylene the most widely used of all plastic ma terials, have been discovered at Be Telephone Laboratories. These protec ants are up to ten times as effective a presently-used antioxidants.

Certain substituted thioethers, whe used in conjunction with carbon black have been found to gain exceptiona antioxidant activity over their use i clear polyethylene. Conventional pro tectants tend to lose their effectiveness i the presence of carbon black. The sub stituted thioethers are formed by th condensation of conventional therma antioxidants, such as aromatic amine or phenols, with sulfur dichloride. Al kyl, aryl and heterocyclic thiols and di sulfides without amine or phenolic sub stitutes are also effective antioxidant when used with polyethylene contain ing carbon black. About 0.1% of the sulfur compound with 3% carbon black is highly effective in reducing both thermal and photooxidation. The carbon black, added to cut down photo-oxida tion, accounts for the fact that a great deal of the polyethlene in use today is black in color.

The best conventional antioxidants protect carbon black-polyethylene formu lations for less than 200 hours under accelerated test conditions of 140°C in an atmosphere of oxygen. Futhermore, the oxidation process becomes autocata lytic—that is, it reaches a point at which it "runs away"—under such test condi tions. With several of the new protect ants, however, oxidation proceeds at a slow, even rate and does not become autocatalytic even after 2000 hours at 140°C. This is equivalent to much more than 20 years of normal service life.

Some of the new additives, such as polmeric organosulfur compounds in cluding thiols and the polymer from 1, 10-decamethylenedithiol, offer possible other advantages. By control of the molecular weight of the antioxidant, its diffusion rate in polyethylene can be varied. Also, by varying the size of the repeating unit in the antioxidant, the concentration of the active groups can be changed without necessarily affecting their diffusion rates. A high concentration of functional groups in comparatively high molecular weight additives allows maximum protection over longer

periods of time. Finally, high molecular weight antioxidants can possibly be added in large enough amounts to act as plasticizers for polyethelene.

Prestressed Concrete Soviets vs. United States

American concrete experts believe that the Russians are far out in front of the U. S. in construction of precast, prestressed concrete multi-story buildings, but fall behind in the use of prestressing for bridges, according to engineers just back from the U.S.S.R.

The three engineers—Prof. T. Y. Lin. University of California; Ben C. Gerwick. Jr., president, Prestressed Concrete Institute, and Prof. Boris Bresler, University of California—were members of a six-man study team that recently returned from Russia.

Russia's huge demand for better housing has placed great emphasis on building construction. Builders are assigned quotas by the government. They work to standard designs after test-building different designs.

Designs are not frozen after standardization, however. A few years ago big multi-story apartment houses were being built of concrete block. Then the Russians shifted to precast concrete elements. Now they are making extensive use of prestressing for such components as wall panels and floors.

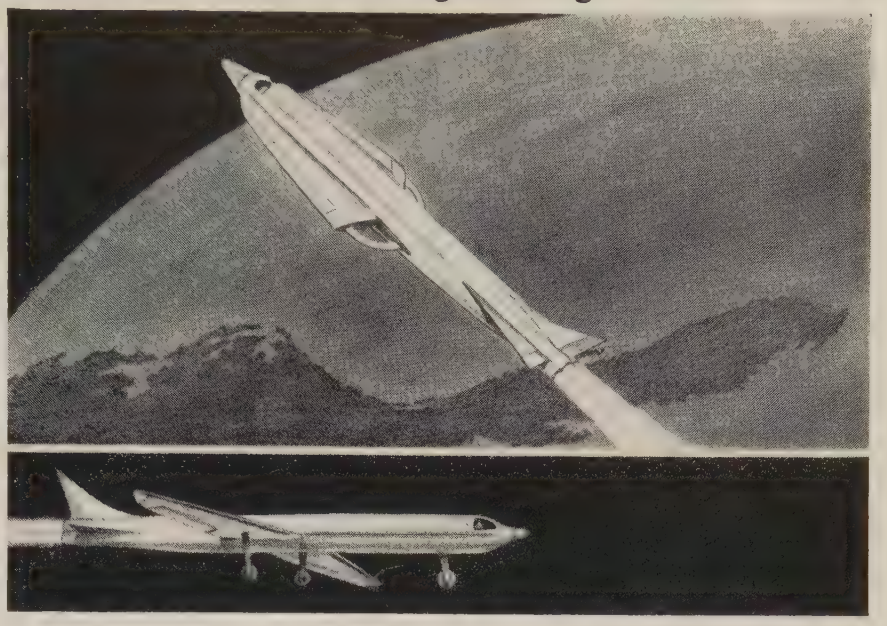
The Russians have a decided advantage in their ability to concentrate research on single projects, the American experts believe. And mass production of a single type or a few types of building is certainly economical. Prestressed elements are rapidly being put into mass production. However, the advantages of low cost and quantity are partly offset by relatively poor workmanship.

Russia apparently has been influenced to a marked degree by construction in other European countries. But there is very little adoption of U. S. techniques. Soviet engineers have developed many original ideas, for example, automatic winding of pretensioning wires for building panels.

Russian engineers seem to have a high degree of freedom of thought. They are somewhat tied down in research work, however, by being assigned specific applied research problems to fit construction goals of the current five-year plan. Fabricating plant operators appear to have more freedom of action. They are assigned specific equipment, but are allowed to work out production techniques themselves, the experts conclude.

"Drink broke up my home."
"Couldn't stop it?"
"No, the damn still exploded."

MARS · outstanding design SERIES

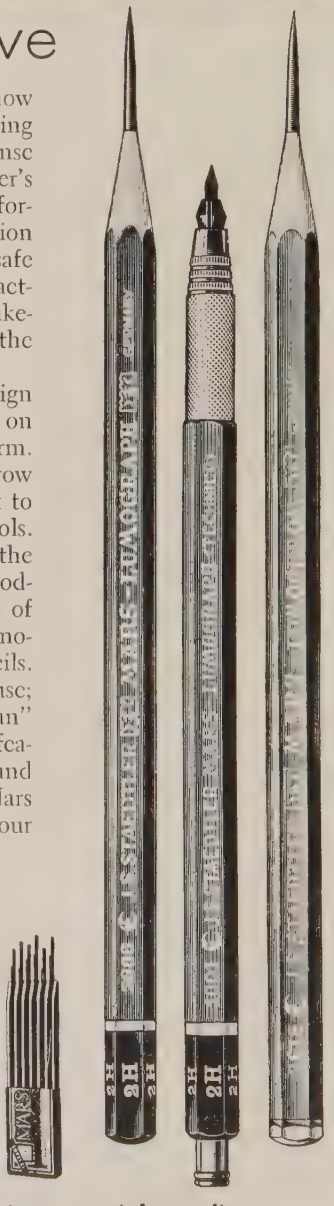


brings 'em back alive

Today's burning problem in space flight is how to ease a rocket safely back to earth, without being consumed by the metal-melting friction of our dense atmosphere. Design Engineer Carl J. Rauschenberger's ingenious suggestion is a pair of wings, locked forward at blast-off, later folded back into flying position (insert) by hydraulic cylinder controls for a slow, safe descent. Mr. Rauschenberger also envisions a retractable glass nose cone, heatproof to withstand the take-off, drawn back to admit air to a jet engine on the return flight.

This outstanding solution to a timely design problem may already exist in working drawings on somebody's drafting board, or even in mock-up form. But whether a project is developed today, tomorrow or the year after next, it will always be important to shape ideas into realities with the best of drafting tools.

In pencils, of course, that means Mars, long the standard of professionals. Some outstanding new products have recently been added to the famous line of Mars-Technico push-button holders and leads, Lumograph pencils, and Tradition-Aquarell painting pencils. These include the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman" pencil sharpener with the adjustable point-length feature; Mars Lumochrom, the color-drafting pencils and leads that make color-coding possible; the new Mars Non-Print pencils and leads that "drop out" your notes and sketches when drawings are reproduced.



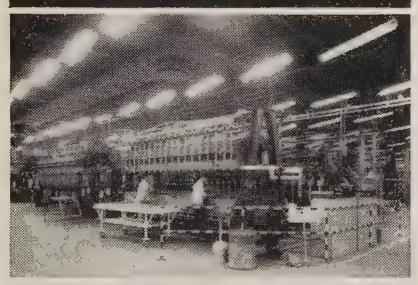
The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom color-drafting pencil, 24 colors.

J.S. STAEDTLER, INC.
HACKENSACK, NEW JERSEY

at all good engineering and drawing material suppliers

The huge Convair-Fort Worth plant is located on the western edge of Fort Worth, and is connected to all parts of the city by a system of limited access freeways.

Nearing completion at Convair-Fort Worth — the world's largest Altitude Chamber of its kind.



Bonded sandwich paneling-pioneered by Convair-Fort Worth — is fabricated in an almost unlimited variety of shapes and sizes.

Final checkout of B-58 is performed with special 50-ton refrigeration unit to cool electronic equipment, and an electric power generator.

Vital statistics for the engineer and scientist interested in a position affording a high potential for professional growth:

- America's largest and most complete air craft manufacturing facility located in the nation's 12th market area
- Nearly half-a-hundred highly advanced Air Force contracts now on hand
- Extensive research and development equipment and facilities
- Broad educational and employee benefits
- First to employ the weapons system management concept
- Latest achievement . . . America's first supersonic bomber . . . the all new B-58

A resume of your training and experience will be evaluated by engineers in the department best suited to your particular qualifications.

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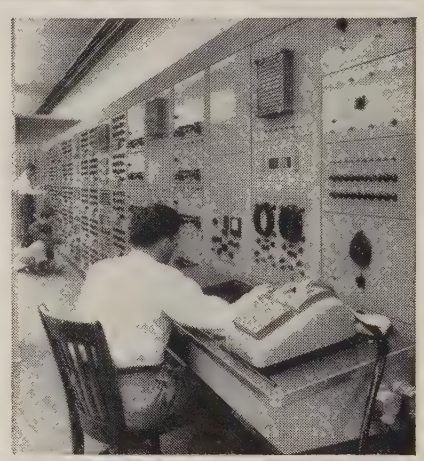
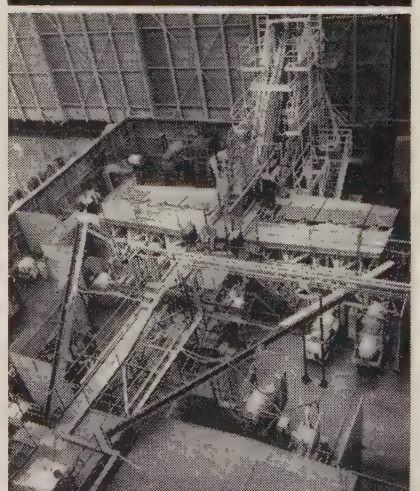
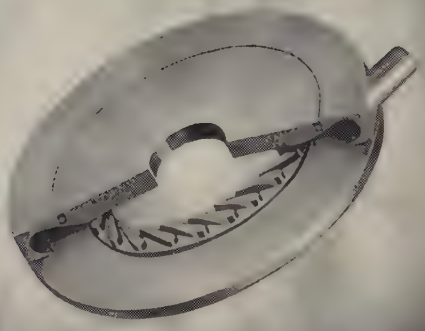


DAEAC — newest and most advanced facility — permits static, dynamic, flutter and steady-state areoelastic testing of the complete airplane by means of direct electrical analog.



Full scale mock-up and test stand for B-58 hydraulic powered flight control system.

REFRIGERATOR WITH NO MOVING PARTS



The vortex tube is a refrigerating machine with no moving parts. Compressed air enters the vortex chamber pictured here and spins rapidly down an attached tube. Pressure and temperature differences build up, forcing cold air out one end and hot air out the other. Requiring no maintenance, a large vortex tube developed by AiResearch scientists and engineers can be permanently sealed in nuclear reactors, and has many uses in industries with spot cooling problems.

Many such pioneering developments are underway in challenging, important work at AiResearch in missile, electronic, nuclear, aircraft and industrial fields.

Specific opportunities exist in system electronics and servo control units; computers and flight instruments; missile auxiliary power units; gas turbine engines, turbine and air motors; cryogenic and nuclear systems; pneumatic valves; industrial turbochargers; air conditioning and pressurization; and heat transfer, including electronic cooling.

ENGINEERING AT GARRETT OFFERS YOU THESE ADVANTAGES:

- **An eight-month orientation program is offered prior to permanent assignment to help you aid us in determining your placement from a variety of analytical or development projects.**
- **Intensified engineering is conducted by small groups where individual effort and accomplishment is quickly recognized providing opportunity for rapid growth and advancement.**
- **Advanced education is available through company financial assistance at nearby universities.**

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LISTENING IN THE E.E. LAB

This is the first in a series of one article written to acquaint the non-engineering reader with the electrical engineering student and his college curriculum.

This report is devoted to the electrical engineering laboratory where groups of aspiring engineering students meet several times weekly to apply the knowledge gained in theory classes towards solving laboratory problems.

To keep the material for this report as non-rehearsed and impromptu as possible, a microphone was concealed in one of the laboratory oscilloscopes and a tape recording was made of the conversations during one laboratory session. This recording is presented in the article.

A glossary is provided at the end of the report to explain all the engineering terms marked with an asterisk.

"Well, here we are again."

"Yah."

"I wonder what kind of an orgy we perform this week?"

"Beats me."

"Anyone read the experiment yet?"

"No."

"Not me."

"I did."

"Damn you, Wilson. You know the rules of our club. Nobody reads the experiment until fifteen minutes after the period starts."

"I must have been out of my mind."

"Milton. Hit Wilson full flush on the mouth with your slide rule*."

"Good grief, I should say that hurt plenty."

"That'll learn yah."

"I guess we might as well get the show on the road."

"Forsooth."

"It says here, 'From your knowledge of the oscilloscope* gained in previous experiments, connect the scope into the circuit shown, so the voltage fluctuations across the unilateral filibuster* may be observed.' "

"Which one of you sluggards have some oscilloscope knowledge?"

"Not me."

"I pass."

"Belch."

"Ain't none of you guys got no smart? How do you turn the scope on?"

"Beats me."

"I pass."

"Belch."

"Wilson, go ask the instructor how to turn this animal on."

"Why should I always be the work horse in this outfit?"

"Slap his young face, Milton.

"Okey, I'll go."

"What did the instructor tell you?"

"He slapped my face."

"This must be the switch. Yah, it's on now."

"What's a unilateral filibuster?"

"Beats me."

"I'm snowed."

"Belch."

"This must be it."

"That's my cigarette."

"Oh, Must be this black thing here. Wilson, go ask the instructor what a filibuster looks like."

"When I was over there the first time he was asking one of the guys if they knew what it looked like."

"Well, we can hook this black thing into the circuit and see what happens."

"It says here, 'Plot the suicidal source current as a function of time measured in hours.' "

"That's sinusoidal, you idiot."

"What does sinusoidal mean?"

"I don't know."

"Where do we put the ammeter* in the circuit to measure source current?"

"Across the source, I guess."

"What happened?"

"The needle went around three times and disappeared."

"Try a bigger meter."

"That needle just went around twice and melted."

"They don't make those meters like they used to. I guess we'll have to fudge that into the report."

"Hey, Bill?"

"What?"

"You learning anything?"

"No."

"It says here, 'Plot the smoke coming from the filibuster as a function of time measured in microseconds."

"Is it smoking yet?"

"No."

"Hold your lighter under it."

"It's still not smoking."

"We'll have to fudge that in the report."

"So be it."

"Gasp."

"What you gasping about, Wilson?"

"I grabbed hold of a hot wire and couldn't let go for five minutes."

"It says here, 'Plot the color of the filibuster as a function of time measured in days.' "

" Iguess we can fudge that into the report."

"Who writes these experiments?"

"I heard they hire a guy from Bus Ad."

"No. They get them out of science fiction magazines."

"I heard when the wheels get together for meetings, the things that come up for discussion they can't find an answer to, they make a lab experiment on."

"Ex post facto."

"Wilson, what in the hell are you up to?"

"I'm putting things away. Aren't we done?"

"Get him, Milton."

"Damn you, Milton. You got me on the nose that time."

"It says here, 'Name twenty practical, everyday uses you can think of for the filibuster?"

"They must have bought a bunch of them from a starving professor and now they don't know what to do with them."

"I know what they can do with them."

"Plot that as a function of time."

"This meter must be war surplus."

"How do you know that?"

"It's marked on here, property of the Union Army."

"Well, what the hell do you know about that?"

"Which one of you guys is taking down the data?"

"I thought you were."

"I thought he was."

"We don't have any data yet."

"We'll have to fudge that into the report."

"What kind of a curve should we use this week for our graphs?"

"I always had good luck with the one with a big sag in."

"Yah. That one always works out pretty good."

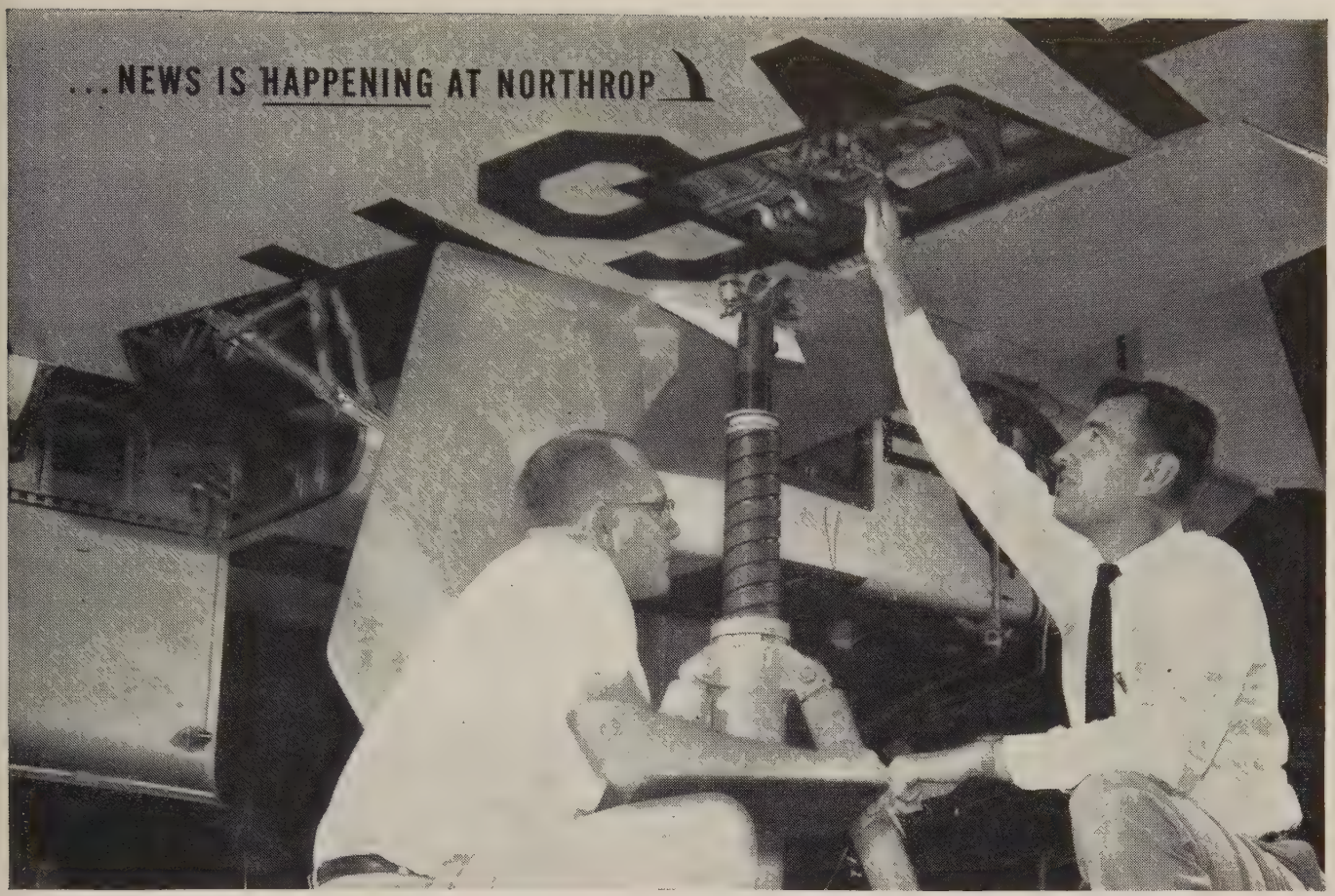
"Sort of hard to make up data for that one."

"Let's use a straight line this time."

"Okey. We can use the other one next week."

"Sounds good to me."

(Continued on Page 52)



On the right, shown following through on pre-flight checkout: Hydraulics Design Engineer Curt Coderre, at 28, responsible for vital systems of the USAF T-38.

Curt (BSME, UCLA, '53) joined Northrop Division during the summer between his junior and senior years, stayed on to become a Northrop 5-year man.

YOUNG ENGINEERS CREATE NEWS AT NORTHROP!

Youthful engineers and scientists discover an ideal, creative work climate when they join Northrop – a growing organization headed by aggressive, forward-thinking management. Northrop's new, dynamic and diversified corporate structure consists of three autonomous divisions – all located in Southern California, all managed by men avidly receptive to fresh ideas.

For the next two minutes, assume that *you* can qualify to join us – that you're a man who wants to create tomorrow's headlines.

You'll choose to join the Division offering greatest challenge for your own special talents, making your choice from the more than 30 different operational fields in which we're actively exploring the future.

You'll earn top money, within a salary structure outstanding in the industry. Increases will come as soon and as often as you earn them, based on your own individual achievement. Fringe benefits include a uniquely liberal vacation policy, among many others.

You'll work with recognized leaders in their fields – highly creative men – fellow engineers especially skilled in developing the talents of younger men. In addition, they operate on the sound principle of delegating their authority, assuring you credit for engineering triumphs.

You'll learn while you earn, with no-cost and low-cost educational opportunities at leading Southern California institutions – earn advanced degrees and keep abreast of latest technological advances in your chosen field.

So, check these facts on Northrop's three Divisions – see which most closely fits your own interests.

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Creators of the USAF Snark SM-62, now operational with SAC. Currently active in programs for the ballistic recovery of orbiting man; flight-testing USAF-Northrop T-38, and readying Northrop's N-156F NATO-SEATO counterair fighter for flight tests.

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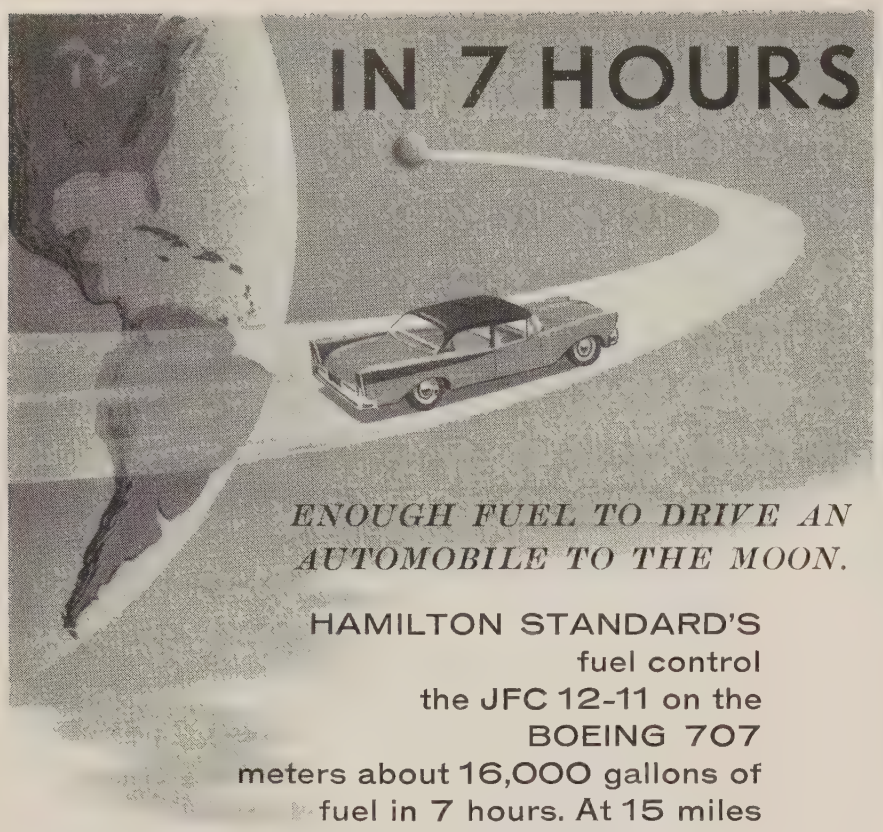
Creator of the world's first drone family; has produced and delivered tens of thousands of drones for all the U.S. Armed Forces. Now developing ultra-advanced target drone systems for weapon evaluation, surveillance drone systems, and guided missile systems.

NORTRONICS DIVISION

Pioneers in celestial and inertial guidance. At Hawthorne: exploring infrared applications, airborne digital computers and interplanetary navigation. At Anaheim: developing ground support, optical and electro-mechanical equipment, and data-processing devices.

WRITE TODAY for complete information on Northrop and all three of its Divisions to: Engineering & Scientific Personnel Placement Office, Northrop, P.O. Box 1525, Beverly Hills, California.

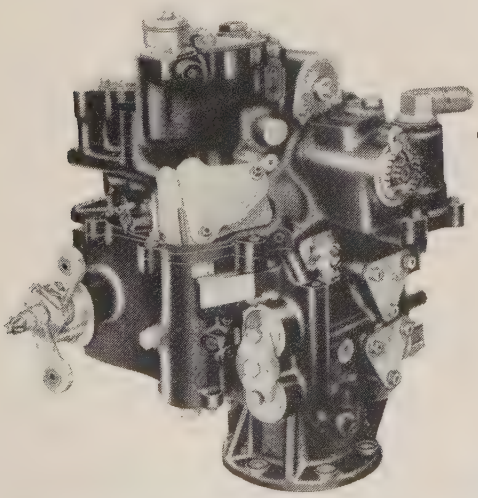
NORTHROP, Beverly Hills, California



ENOUGH FUEL TO DRIVE AN AUTOMOBILE TO THE MOON.

HAMILTON STANDARD'S fuel control the JFC 12-11 on the BOEING 707 meters about 16,000 gallons of fuel in 7 hours. At 15 miles per gallon, an automobile would consume that much in 240,000 miles.

This amazing performance is accomplished by the JFC 12-11. This lightweight, rugged, and highly sensitive unit contains a computing system and a metering system to control engine thrust. Such precision engineered components as *pressure sensing bellows, multiplying linkages, servo pistons, filtering systems, relief valves and "three D" cams* must function simultaneously to meter required fuel flow for top performance. The basic control features have been proven by over a million hours of actual flight time.



If you are interested in designing and developing such products as this, contact Timothy K. Bye Engineering Personnel Coordinator, or arrange for an interview with your college placement officer.

HAMILTON STANDARD

DIVISION OF UNITED AIRCRAFT CORP.

202 BRADLEY FIELD ROAD WINDSOR LOCKS, CONNECTICUT

(Continued from Page 50)

"Good enough."

"Belch."

"My God. I've been shot."

"What happened to Wilson?"

"He fainted. He said someone sh him."

"I charged up the big capacitor* a touched one wire to each of his e lobes."

"That's a pretty good joke, Milto I'll have to remember it."

"You got a good head on you, M ton."

"Where am I?"

"Get off the floor and stop goofi off, Wilson."

"Our fuse* just burned out again

"They don't make those fuses lil they used to. Short a wire across it."

"What do you think was on there b fore?"

"It says here, 'Derive equations to f each curve that you will plot, et ceter ad nauseum.' "

"I think we can find a couple formu las written on the walls in the men head downstairs that should fit into th report."

"Yah. There should be a couple ther we can fudge in."

"Hey, Bill."

"Yah."

"You learned anything?"

"Yah. I just learned that I'm goin to transfer to commerce."

"Hand me that wire."

"This one?"

"Yah."

"Wow."

"You get a shock?"

"I saw my whole life flash by me."

"That must be the hot side of th circuit then. We have to show in th report which side of the circuit is hot."

"Eureka."

"What's up?"

"I found a microphone someone for got in the oscilloscope."

"You got a pair of pliers?"

"I could use this mike with my ham set."

Snip.

Editor's note: The four students in volved in this recorded conversation were stripped of their epaulets and brass buttons, had their slide rules broken in half over the dean's knee, and were drummed out of the corps.

Glossary:

Ammeter — A meter used to measure the amms flowing in a circuit.

Capacitor — Replacement for the condenser.

Fuse — Common replacement for the copper penny.

Oscilloscope — Single channel television.

Slide rule — Slip stick.

Unilateral filibuster — You name it.

It takes imagination...

It takes *engineering imagination* to design and develop practical applications for the many recent technological advances. Applying the principles of multiplier and divider circuits, as found in digital computers, to the determination of accuracy in watthour meters — our engineers have designed and built an automatic error computer. Use of this computer has increased individual production in testing of watthour meters to approximately 250 units per day. The installation is one example of the dividends resulting from Wisconsin Electric Power Company's policy of performing its own design and development work.

We're looking for men with qualities like these!

This policy also results in *dividends* for the young engineer. Even with skill, foresight, imagination and judgment, a person must find a receptive environment to enable him to exercise and develop these qualities. At Wisconsin Electric Power Company you will find such an environment. You will have a chance to use your engineering skills in a wide variety of fields — electrical, mechanical, civil, chemical, statistical, research, sales, administrative, etc.

Demands for our services are so great that our current expansion program anticipates the doubling of our facilities within a 10 year period. We invite you to grow with us. Whatever your work may be, it will be worthy of achievement and will bring with it the material rewards which accompany success.

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There's much more to it than just the size of the FISH and the size of the POND

O

We've been told that an engineering graduate is frequently attracted to companies our size because of his understandable human desire to be "a big fish in a little pond".

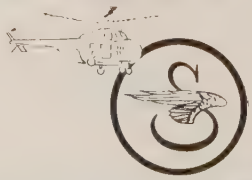
While it is true that (numerically speaking) our employee team is small compared to some, we encounter great difficulty in trying to think of Sikorsky Aircraft as a "little pond". Our contributions to the field of rotary-winged aircraft have not been small, nor can our field be considered limited or professionally confining. Quite the contrary. Sikorsky Aircraft is the company which *pioneered* the modern helicopter; and our field today is recognized as one of the broadest and most challenging in the entire aircraft industry.

And what of the size of the "fish"?

Unquestionably, that is a matter involving your own individual potential for growth. Like any far-sighted company, we're always willing to talk with "young whales"!

For factual and detailed information about careers with us, please write to Mr. Richard L. Auten, Personnel Department.

SIKORSKY AIRCRAFT



ONE OF THE DIVISIONS OF UNITED AIRCRAFT CORPORATION

BRIDGEPORT-STRATFORD, CONNECTICUT

"Organizations do not make men— it is men who make organizations"

CRAWFORD H. GREENEWALT, PRESIDENT
E. I. DU PONT DE NEMOURS & CO. (INC.)

"It is what men bring with them in the way of character and adaptability and fresh ideas that enriches the organizational bloodstream and insures corporate longevity." This is the observation of Crawford H. Greenewalt, President of the Du Pont Company.

In a lecture given in the past year at Columbia University, Mr. Greenewalt outlined his views on the role of the individual in the organization. "The Du Pont Company's success over the last 150 years," he pointed out, "has come about in large part through devoted allegiance to two major themes . . .

"First, the realization that an enterprise will succeed only to the extent that all individuals associated with it can be encouraged to exercise their highest talents in their own particular way.

"Second, the provision of maximum incentives for achievement, particularly in associating the fortunes of the individual to that of the corporation.

"Men are not interchangeable parts, like pinion gears or carburetors. Individuals differ in approach and method, and, to perform to best advantage, they must never be fettered to approaches and methods not their own."

"Conformity" obviously takes a back seat here. As Mr. Greenewalt comments, "We conform as is necessary to good manners, good relationships and the highest use of individual talent. And bear in mind that these are strictures on behavior, not on creative thought."

If you find this kind of atmosphere challenging it will pay you to explore career opportunities with Du Pont.

DU PONT
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BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Begged, Borrowed, and . . .

Edited by The Staff

An Eng. major, taking his first ride on a bus, lit up a cigarette as he sat reading the advertisements overhead.

Finally the driver came along, tapped him on the shoulder, and said, "Whatso matter, can't you read, buddy? That sign up there says NO SMOKING!"

"Yeah," said the Engr. "But the one next to it says, wear Playtex Girdles, so I ain't paying any attention to either of 'em."

* * *

Clerk: "Yes sir, that medicine is sure powerful. Best stuff we have for the liver. Makes you peppy."

Customer: "Can you give me any references of people who have taken it with good results?"

Clerk: "Well, there was a man living next door who took this liver medicine three years."

Customer: "Well, did it help him?"

Clerk: "He died last week."

Customer: "Oh?"

Clerk: "But they had to beat his lier with a stick for three days before they could bury him."

* * *

Daughter: "What should I do if the brakes give way?"

Father: "Steer for something cheap."

* * *

"What's the matter with you?" the engineer's wife demanded. "Monday you liked beans, Tuesday you liked beans, Wednesday you liked beans; now Thursday, all of a sudden, you don't like beans."

* * *

Vocational adviser to youth: "Your vocational aptitude test indicates that your best opportunities lie in a field where your father holds an influential position."

* * *

An elderly man approached a small boy and asked: "Tell me, young man, do you have a fairy god-father?"

"No," replied the little boy, "but I have an uncle we're all a little suspicious of."

* * *

E.E. "May I have your daughter for my wife?"

Father: "Bring your wife over and we'll see."

He: "I'll be tickled if we find a filling station soon; we're almost out of gasoline."

She: "I'll be tickled if we don't I suppose."

* * *

"The man who marries my daughter will get a prize." "May I see it please?"

* * *

Recent tests in the biology department prove that grasshoppers hear through their legs. When a tuning fork was placed near a grasshopper, it was found that in all cases the insect would hop. There was no reaction, however, to this stimulus when the insect's legs were removed.

* * *

"You've read that passage wrong, Miss Adams—it's 'All men are created equal,' not 'All men are made the same way'."

* * *

The baby sardine saw its first submarine and went swimming in terror to its mother. "Don't be frightened, darling," she reassured him, "It's only a can of people."

* * *

Typist: "But, professor, isn't this the same exam you gave last year?"

L.A.S. Professor: "Yes, but I've changed the answers."

* * *

History Professor: "What is a monarchy?"

CE: "A people governed by a king."

Prof.: "Who would reign if the king should die?"

CE: "The queen."

Prof.: "And if the queen should die?"

CE: "The jack."

* * *

One day a little mouse was hurrying across a wheat field when suddenly it was scooped up by a big reaping machine; the poor little mouse was tossed from side to side, and was finally thrown back on the field. Another little mouse came upon his friend lying on the ground, bruised and beaten, and asked him what happened.

"I've been reaped," came the reply.

* * *

The amount of sleep required by an engineer is about five minutes more.

A sexton, cleaning up the pulpit aft Sunday service, took a peek at t preacher's manuscript. Along the le margin were instructions such as "Pau here," "Wipe brow here," "Use ang gesture," "Look upward."

Near the end was a long paragra of texts, opposite which the preach had marked in large capital lette "ARGUMENT WEAK HER YELL LIKE HELL!"

* * *

Professor: "This exam will be co ducted on the honor system. Please tak seats three seats apart and in alterna rows."

* * *

Mud thrown is ground lost.

* * *

d (hi) (ho) = (hi)d (ho) + (ho) d(hi).

* * *

The mother of triplets was bein congratulated by a friend. "Isn't i wonderful," said the mother. "It hap pens only once in 18,769 times."

"That certainly is remarkable," sai the friend, "but tell me, when do yo find time to do your housework?"

* * *

First Medic: "I grafted an arm o a man and now he can play tennis lik an expert."

Second Medic: "I grafted a leg on man and now he's one of the best run ners in the world."

Third Surgeon: "I grafted a smil on a jackass and today's he's a Con gressman."

* * *

A married man returned home one night at a late hour and, having difficulty with his equillibrium, made considerable noise in the hallway. Suddenly there was a sound of crashing glass which awakened his wife.

"John," she called, "what's the matter?"

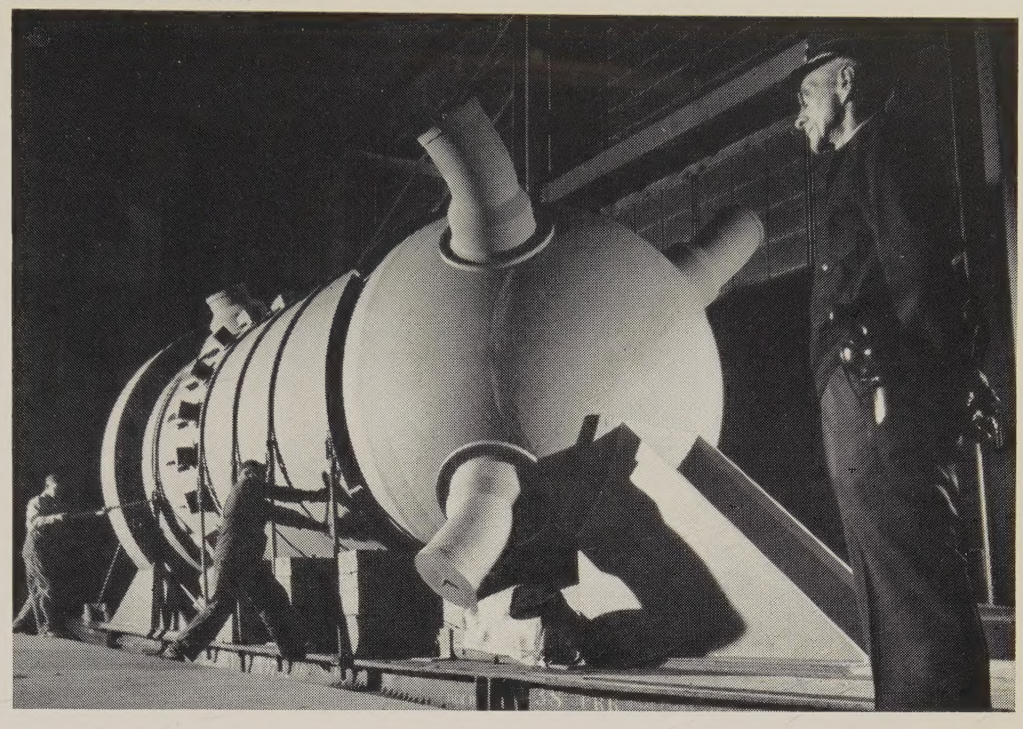
From downstairs came a low mumble. "I'll teach those goldfish to bark at me."

* * *

Judge: What's your occupation?

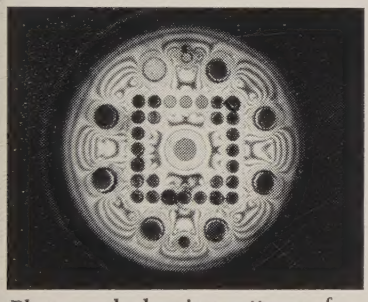
Culprit: "I'm a hospital orderly.

Judge: Thirty days for panhandling.

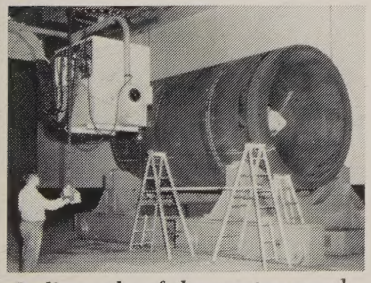


Nuclear reactor vessel for Shippingport, Pa. power plant designed by Westinghouse Electric Co. under contract with the A.E.C. for operation by Duquesne Light Company.

Where atoms turn into horsepower



Photograph showing patterns of stress concentration. It was taken of a plastic model of a reactor vessel loaded to simulate the strains a real reactor vessel would undergo.



Radiographs of the reactor vessel welds were made with a 15,000,000-volt betatron. Every bit of the special steel, every weld had to be proved sound and flawless.

Combustion Engineering designed and built this "couldn't-be-done" reactor vessel for America's first full-scale nuclear power station. And photography shared the job of testing metals, revealing stresses and proving soundness.

COUNTLESS unusual—even unique—problems faced Combustion Engineering in creating this nuclear reactor vessel. Nine feet in diameter with walls 8½ in. thick, it is 235 tons of steel that had to be flawless, seamed with welds that had to be perfect. And the inner, ultrasmooth surface was machined to dimension with tolerances that vie with those in modern aircraft engines.

As in all its construction, Combustion Engineering made use of photography all along the way. Photography saved time in the drafting rooms. It revealed where stresses and strains would be concentrated. It checked the molecular structure of the steel, showed its chemical make-up. And with gamma rays it probed for flaws in the metal, imperfections in the welds.

Any business, large or small, can use photography in many ways to save time and money. It can go to work in every department—design, research, production, personnel, sales, and accounting.

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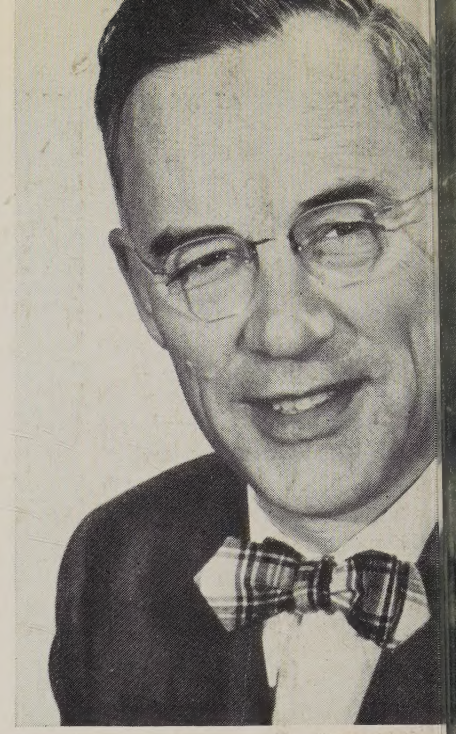
One of a series

General Electric interviews Dr. Richard Folsom, President of Rensselaer Polytechnic Institute, to explore . . .



Teaching— A Career Opportunity For the Engineer

Leading educators, statesmen and industrialists throughout the country are greatly concerned with the current shortage of high-caliber graduates who are seriously considering a career in the field of science or engineering education. Consequently, General Electric has taken this opportunity to explore, with one of America's eminent educators, the opportunities and rewards teaching offers the scientific or engineering student.

Q. Is there in fact a current and continuing need for educators in technical colleges and universities?

A. Colleges and universities providing scientific and engineering educational opportunities are hard pressed at the present moment to obtain the services of a sufficient number of well-qualified teachers to adequately carry out their programs. Projected statistical studies show that this critical need could extend over the next 15 or 20 years.

Q. Why is this need not being met?

A. There are probably three main reasons. These might be classed under conditions of financial return, prestige associated with the position, and lack of knowledge and understanding on the part of the college student of the advantages and rewards teaching as a career can afford.

Q. What steps have been taken to make education a more attractive field to engineering students?

A. Steps are being taken in all areas. For example, we have seen a great deal in the newspapers relating educators' salaries to the importance of the job they are doing. Indications are that these efforts are beginning to bear fruit. Greater professional stature is being achieved as the general public understands that the youth of our nation is the most valuable natural resource that we possess . . . and that those associated with the education of this youth have one of the most important assignments in our country today.

Q. Aside from salary, what rewards can a career in education offer as opposed to careers in government or industry?

A. The principal rewards might be freedom to pursue your own ideas within the general framework of the school, in teaching, research and consulting activities. As colleges and universities are normally organized, a man has three months in the summer time to engage in activities of his own choice. In addition, the educator is in direct contact with students and he has the satisfaction of seeing these students develop under his direction . . . to see them take important positions in local and national affairs.

Q. What preparation should an engineering student undertake for a teaching career?

A. In college, the engineering student should obtain a basic understanding of science, engineering science, humanities and social sciences with some applications in one or more professional engineering areas. He should have frequent career discussions with faculty members and his dean. During graduate work, a desirable activity, the student should have an opportunity to do some teaching.

Q. Must an engineering student obtain advanced degrees before he can teach?

A. It is not absolutely necessary. On the other hand, without advanced degrees, advancement in the academic world would be extremely difficult.

Q. How valuable do you feel industrial experience is to an engineering or scientific educator?

A. Industrial experience for a science educator is desirable; however, with a senior engineering educator, industrial experience is a "must". An ideal engineering educator should have had enough industrial experience so that he understands the problems and responsibilities in carrying a project from its formative stages to successful completion, including not only the technical aspects, but the economic and personal relationships also.

Q. What do you consider to be the optimum method by which an educator can obtain industrial experience?

A. There are many methods. After completion of graduate school, perhaps the most beneficial is a limited but intensive work period in industry. Consulting during an academic year or summer is a helpful activity and is desirable for older members of the staff. Younger educators usually need experience in "living with the job" rather than providing consultant's advice to the responsible individual.

Q. Based on your experience, what personal characteristics are possessed by successful professors?

A. Primarily, successful professors have an excellent and growing knowledge of their subjects, are interested in people, and transmit enthusiasm. They have an ability to explain and impart information with ease. They generate ideas and carry them out because they are devoted to developing their fields of knowledge. They desire personal freedom and action.

For further information on challenging career opportunities in the field of science and engineering education, write to: Mr. W. Leighton Collins, Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill.

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